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European Iron Castings Production

For the first time as far as we remember, there has now been made available through the Quarterly Bulletin of Steel Statistics, prepared at Geneva by the Economic Commission for Europe of the United Nations, the output of iron castings annually from the various European countries. The productions are set out in metric tons, and, like all other statistics, are not strictly comparable one with another. There are in many cases footnotes which carry such phrases as " including unmachined castings "; " cast-iron pipes only (some two-thirds of total production)"; " including malleable castings " and so forth.

The largest producer in Europe is the United Kingdom, and heads the list with 3,543,000 metric tons for 1950, the latest figures to be given. An approximate figure of 3,000,000 tons is given as the average production in the immediate pre-war years. Here we should make a mental reservation, as large quantities of tunnel segments were being made and they rank as heavy castings. However, the Geneva guess is as good as ours. Germany comes second in order of production, with 1,980,000 tons (1950) but in 1938 the Germany of those days made 3,640,000 tons. Next comes France, where, post-war, the figures reveal a constantly-expanding industry. In 1938, the production was of the order of 859,000 tons; this by 1946 had dropped to 576,000 tons. Since then, each year has shown an expansion until, in 1950, the output was reported at 1,040,000 metric tons. Fourth in the order of production is Italy with 422,000 tons, followed by Sweden (330,000 tons), and Belgium (260,000 tons). In Belgium, production has declined from a 320,000 tons maximum in 1948. The other European countries have a five-figure production and they are Holland 172,000 tons; Saar and Denmark, each 120,000 and Austria 116,000 tons.

It appears that in 1951 steel production for Europe was expected to be of the order of 67,900,000 tons. The United Kingdom is the only important steel-producing country showing a lower rate of crude-steel production in 1951 than in 1950, due to having received only 414,000 tons of scrap as against 1,699,000 (during the first nine months in each year). However, European pig-iron production should have reached a 1951 total of 49.4 million tons or an increase of 13.9 per cent. which has gone some way towards compensating for the scrap shortage. Coke production has increased, but in some cases is inadequate.

Now, these figures are not only interesting but useful, as they indicate where competition may be expected and where a major consumption of foundry supplies and plant occurs. Yet the major problem posed is the future supply of scrap. Machinery and plant supplied to the home market will only start to yield a satisfactory equilibrium when buying of new equipment is reduced to a replacement level. From exports it is doubtful whether there will ever be a return of obsolete machinery and the like. Thus for many years to come, reliance will have to be placed on the production of increased supplies of pig-iron, and this country's policy should be the increase in blast-furnace capacity, coke production and exploiting of iron-ore reserves. As a country, we cannot go on scraping the bottom of the barrel indefinitely.

E

New Year Message

From the Chairman of The Council of Ironfoundry Associations

Despite the anxieties we have had about raw materials, I expect the final production figures for 1951 will show that the ironfoundry industry has managed to set up a record annual output. There has been a progressive increase year by year since the end of the war. The prospect of a further expansion in 1952 is not very bright. Most foundries, like my own, have exhausted reserves of scrap, and our rate of output will largely depend upon the current receipt of materials.

Our efforts to secure for the industry a fair share of the available materials will be strengthened if we can impress on public opinion the basic importance of iron castings. The Council has started this work on a national scale; and every ironfounder can support the movement in many ways, both in his own section of industry, among his customers, and in his local community. For example, the chairmen of companies can give useful publicity to the ironfounding industry in their addresses to shareholders, and foundry managements can do more to enlist the interest and support of the editors of their local newspapers. Individual efforts of this kind will all help to gain wider public recognition of the real stature of our industry.

Another way in which we can strengthen the industry is by trying to enrol into our constituent associations more of the ironfounders who are still outside our membership. The Council intensified this recruitment work last year, with an encouraging measure of success. I was interested to read a company report published in a financial newspaper last month in which the head of a well-known steel firm generously acknowledged the valuable services of the trade association in his own industry. Friendly publicity of this kind might do much to stimulate the recruitment of new members in to the ironfounding associations.

The new Government's proposals for the iron and steel industry are under consideration and will probably occupy the attention of Parliament in the early months of the year. As consumers of pig-iron, all ironfounders have a vital interest in the wellbeing of this great industry, and we hope that its future development can be secured from the uncertainties of party politics.

As in my first message to you two years ago, I again wish each of you health and success throughout the coming year.

N. P. NEWMAN

Warning to Metal Thieves

At the opening of Leeds Quarter Sessions, last week, the Recorder of Leeds, Mr. G. Raymond Hinchcliffe, K.C., suggested that scrap-metal dealers should exercise the greatest care and question closely all sellers of metal. Mentioning that there had been many more offences of petty larceny in this quarter than in the corresponding quarter the previous year, he said that the increase was for the most part due to the stealing of scrap metal, as at present all kinds of scrap metal, being scarce, fetched high prices. He added that in Leeds courts sharp sentences had always been imposed on persons convicted of stealing and receiving scrap metal, and in view of the increase in that type of crime, no mercy would be shown in future. Mr. Hinchcliffe stated that the total number of indictable offences for the quarter was 1,395, an increase of 328. One satisfactory feature was the fact that the police had arrested a considerable proportion of those attempting to live on crime.

Acknowledgments

Greeting cards and gifts of diaries and calendars are gratefully acknowledged from the following :—

Aero Research, Limited; Aluminium Development Association; Mr. W. E. Aske; Mr. A. Augstein; Mr. J. Augstein; G. & W. Base & Industrial Minerals (Pty.), Limited; Mr. L. G. Beresford; Birlec, Limited; Mr. J. Bolton; British Bath Company, Limited; British Industrial Plastics, Limited; British Iron and Steel Research Association; British Oxygen Company, Limited; British Tabulating Machine Company, Limited; Mr. J. Butler; David Brown (Huddersfield), Limited; Mr. J. Cameron; Chaseside Engineering Company, Limited; G. Cohen Sons & Company, Limited; Coneygre Foundry, Limited; Constructional Engineering Company, Limited; Davidson & Company, Limited; Mr. F. C. Evans; Eyre Smelting Company, Limited; Frodair Iron & Steel Company, Limited; Fulmer Research Institute; Gas Council; Dr. R. Genders; Mr. W. Gibson; Mr. Colin Gresty; Mr. H. Hall; Miss C. Hanson; Mr. R. Hanson; John Harper & Company, Limited; Mr. W. Harper; Harrison & Sons, Limited; H. Hendra & Son; High Duty Alloys, Limited; J. Hobkirk Sons & Company, Limited; Holman Bros., Limited; Incandescent Heat Company, Limited; Institution of Production Engineers; International Alloys, Limited; Mr. K. S. Jewson; Mr. J. F. Kayser; K. & L. Steelfounders & Engineers, Limited; Mr. H. W. Keeble; Mr. J. Kinsman; B. Levy & Company (Patterns), Limited; Lim & Lim, Limited; Mr. A. Lloyd; Mr. Quentin Lumsden; Mr. Tom Makemson; Mr. B. Maloney; Mavor & Coulson, Limited; Mr. C. Monseur; Mr. W. G. Mochrie; Newcast Foundries, Limited; Newton Chambers & Company, Limited; W. H. N. Nicholls Company, Inc.; North Eastern Iron Refining Company; Northern Manufacturing Company; Nuffield Organization; Oelrichs Advertising Agency; Peregrine & Partners; Mr. C. R. Purley; Pont-à-Mousson; Pyrene Company, Limited; Mr. J. Preston; Richardson Engineering (Birmingham), Limited; Mr. Frank Rowe; Mr. S. H. Russell; S. Russell & Sons, Limited; Ruston & Hornsby, Limited; Mr. E. Salinger; Safety Products, Limited; Mr. H. H. Shepherd; Mr. O. Smalley; Stein & Atkinson, Limited; Stewarts and Lloyds, Limited; Stork Engineering Works; Mr. F. Tibbenham; Mr. W. Toomey; Western Foundries; Zinc Development Association.

Proposed Institution of Safety Officers

Most foundry managements in the Birmingham area have as their safety officers men who are active members of the Birmingham and District Industrial Safety Group, and there is general satisfaction that an idea first put forward by the Group in 1943—that an Institution of Safety Officers should be formed—is now to become effective. The immediate result of the 1943 suggestion was an interim scheme by which the Royal Society for the Prevention of Accidents formed an industrial safety officers' section, and this—with branches in London, Birmingham, Sheffield, and Manchester—has flourished so well that it is now proposed that the 500-strong section should withdraw from the Royal Society to form an independent body on lines similar to other professional associations. The emphasis on the fact that members must be qualified, full-time industrial safety officers, will ensure the high standard of professional competence that many authorities such as Factory Inspectors have long been urging. The foundry industry, where the accident potential is high, will welcome any project which promises better safety techniques and more factual dissemination of accident-prevention methods.

Crossley Brothers Modern Foundry Developments*

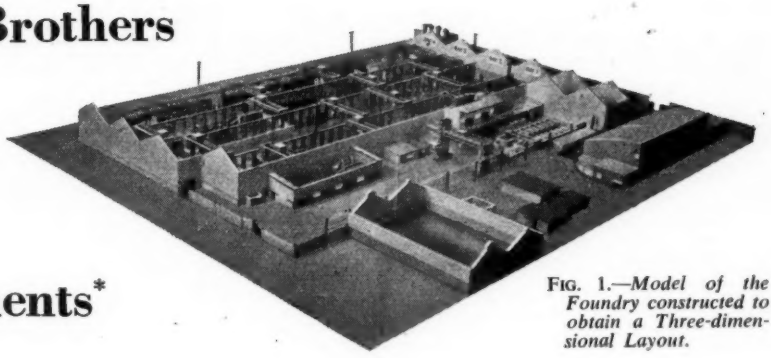


FIG. 1.—*Model of the Foundry constructed to obtain a Three-dimensional Layout.*

Crossley Brothers, Limited, at Openshaw, Manchester, were pioneers in the British Isles of the internal combustion engine and have devoted more than 80 years to its exclusive manufacture. The company continues to occupy a leading position in the development of this specialized industry and one of the major problems facing an enterprising firm is that of expansion, including notably the increased production of ferrous and non-ferrous castings. To this end, a new site has been developed at Openshaw, and a foundry comprising four main bays, with ancillary sections has been erected and is now in operation. What follow are sectionalized descriptions of the departments and work catered for in this modern foundry.

To meet the growing demand for products for marine, land and traction purposes an expansion in both foundry and machine-shop capacity was necessary at the Crossley works. A new site in close proximity to the main works at Openshaw was therefore acquired for a modern foundry, and the space formerly occupied by the old foundries has been applied to extensions of the machine-shop. The new foundry (Fig. 1) is self-contained with its own patternshop, stores, canteen, baths, and welfare facilities, associated with an up-to-date engineering factory. Castings of high quality in a great variety of sizes are produced for the main works at Openshaw and branch works at Reddish, near Stockport. Castings are also supplied to an associated company, Crossley-Premier Engines, Limited, at Sandiacre, near Nottingham.

Layout

The four bays which comprise the main foundry building are 480 ft. long, three of them being 50 ft. wide and the fourth 59 ft. wide. The floor throughout is of concrete with the exception of one section in which the largest castings are made. Sixteen overhead cranes with capacities varying between 5 and 45 tons serve the bays, and these are supplemented by a number of jib arms with lifting capacities up to 1 ton which are used for core assembly.

Owing to the large variety of work and differing sizes of moulding boxes involved it is not possible to employ cooling tunnels with fume-extraction facilities. Fumes are effectively removed, however, by a carefully-considered ventilation system which includes over 20 rotary roof-ventilators and 15 large extractor fans. The foundry as a whole has a high roof with skylights so that adequate fresh air at floor level is assured.

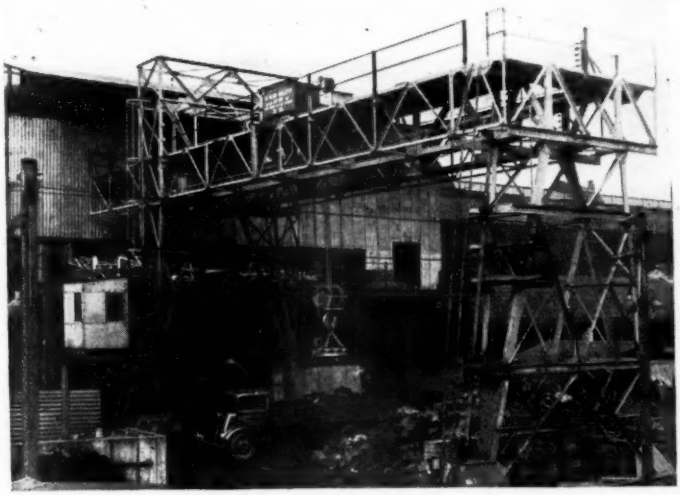


FIG. 2.—*"Goliath" Crane discharging Scrap for Addition to the Cupola Materials at the Melting-shop Side.*

* Reprinted, slightly abridged, from *Crossley Chronicles.*

FIG. 3.—*No. 1 Bay, showing (on the right) the Moulding Machines and their Overhead Hoppers and Belt Conveyors.*

Outside the main building are arranged four cupolas (one 48 in. giving 7 to 8 tons per hr., two 37 in., 4 to 5 tons per hr., and one 27 in., 2 tons per hr.), in a housing with its own roof and charging platform. These are served by a "Goliath" crane (Fig. 2) which can run the full length of the foundry, and by a 2-ton electric hoist within the housing itself. Raw materials for the cupolas, *i.e.*, pig-iron, coke and limestone, etc., are stored in a stockyard running alongside the cupola housing, the

FIG. 4.—*Close-up of the Separate Sand Plant serving the Greensand Moulding Section with its Five Machines.*

pig-iron being discharged directly from railway wagons by a magnetic pick-up on the "Goliath" crane. Bins for the storage of other materials are also fed directly from the railway.

The foundry is well served by railway lines for, in addition to that serving the stockyard, another line delivers material to the core and loam-sand mills situated at the end of the core-making bay; this line also passes the end of the dressing shop for the transport of finished castings. Another line passing across the middle of the four bays is used for the movement of large moulding boxes to the stockyard and for the transport of ladles of molten metal between the bays.

Number One Bay

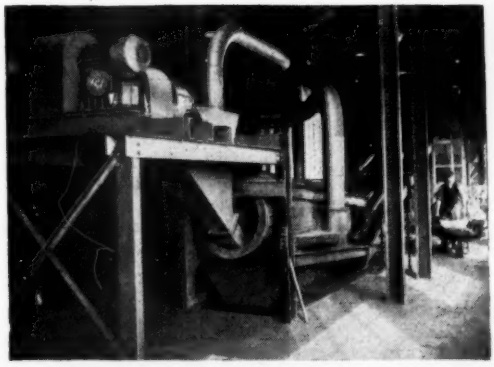
The spouts from the cupolas are arranged to discharge into No. 1 bay (Fig. 3), the cupolas and all metal-mixing being under laboratory control. A large amount of special high-duty cast iron is produced and much of the alloy for this is melted in a 33-cwt. oil-fired Morgan tilting furnace close by. It is weighed out as required and poured into the large ladles of molten iron at the same time as the other ladle additions are made and all metal is accurately weighed to ensure the correct grade of iron being obtained.

At the same end of the bay, a section is engaged in the production of small green-sand moulds (Fig. 4) and is equipped with five machines. The sand for this work, being of the "unit" type, is prepared in an independent sand plant similar in arrangement to the plant supplying the larger machines, the whole being supplied by August's, Limited. Sand is taken directly from a storage bin at the end of the railway which runs alongside the cupola housing. As in the case of larger machines, a conveyor belt above the machines supplies each hopper with sand and this can be discharged as required by the machine operator, who by moving a lever at the bottom of his particular hopper allows the sand to fall vertically into the moulding box.

When finished, moulds are banked on roller conveyors for casting, after which they are moved on to a mechanical shake-out. The sand returns to the sand plant (Fig. 6) by underground conveyor and the empty boxes to the machines for further use. This is not a continuous plant as casting takes place only twice per day, but it is a very flexible arrangement and caters admirably for a large number of different types of casting.

Dry-sand Moulding

Medium-size dry-sand moulds are produced in one half of No. 1 bay and the moulding machines, which comprise five Jackman roll-over jolting machines for moulding boxes up to 3 ft. long by 3 ft. wide, and one plain jolter of the same make for boxes as large as 7 ft. long by 4 ft. wide, are supplied with facing and backing sand by overhead hoppers. These are fed by a large sand-preparation plant housed in a building outside the main bays.



FIGS. 5 AND 6.—*Sand-preparation Plant serving the Moulding Machines and Close-up of the Overhead Belt Conveyor showing the Ploughs.*

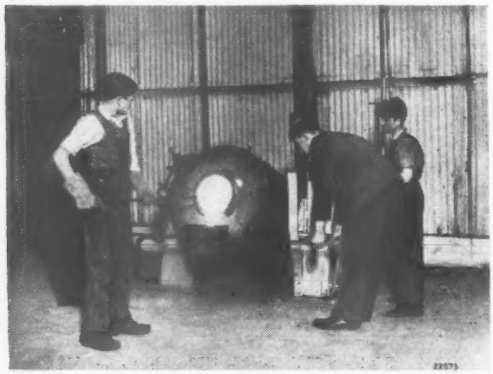
FIG. 7.—*Sandslinger shown Ramming-up a Large Mould; the Sand Plant serving the Machine can also be seen.*

Crossley Brothers Modern Foundry

Sand-preparation Plant

Used sand, knocked-out over floor grids in No. 2 bay, travels on an underground conveyor across the bays to the sand plant, where it is cleaned of silt and small coke, etc. Any metal which may be present is removed magnetically and the sand passes to two large hoppers. From there, the cleaned sand, with an added proportion of new sand and coal-dust, is elevated by bucket loaders to the sand mills and after milling is discharged by pneumatic control on to a belt which conveys the sand to a bucket elevator which in turn feeds the belt conveyor above the moulding machines. By means of a scraper (Fig. 6), which is directed from each machine, the sand can be ploughed from the belt into the required hopper. Both facing and backing sands are sent along the belt, each moulding machine having two separate hoppers, *i.e.*, one for each type of sand.

Backing sand, of which considerable quantities are required, is fed from the bottom of its hopper on to a secondary motor-driven belt on which the sand travels forward to drop into the moulding box. For the large jolting machine, the secondary belt is fitted to a turntable which allows the falling sand to move along a moulding box of the maximum size carried by the machine. The section is served by four coke-fired mould stoves and, after drying, the moulds pass into the next bay for further operations.



Number Two Bay

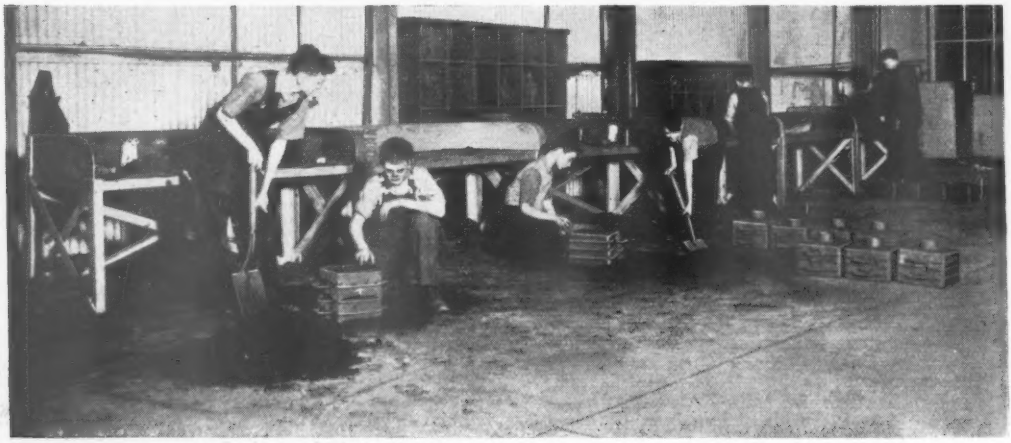
A large portion of No. 2 bay is given up to core-assembly and the closing and casting of the larger moulds produced in No. 1 Bay. This section also contains pits for the castings of cylinder liners. At the end of the bay is a knock-out, also the fettling and dressing section of the foundry. Loose- and plate-pattern moulding is carried on in another portion of this bay. Three large mould stoves, are situated at the other end of the dressing section and planned in such a manner as to avoid encroachment on valuable floor space. It may be mentioned, also, that all the mould- and core-drying stoves are of the latest type, with exhaust and supply of dry hot air from a single fire-box for each group of stoves.

Number Three Bay

In this bay are produced all the large castings which form major components of the engines. The work involved is heavy and demands a high degree of skill, as a large number of intricate cores are used. To facilitate ramming up of these large moulds, a motive-type Sandslinger (Fig. 7) with a radius of 20 ft. is employed, the rails for this machine extending 250 ft. It is served by its own sand-preparation plant, which feeds three hoppers and these in turn supply sand to a hopper on the Sandslinger itself.

As in No. 1 bay, used sand is knocked-out over grids on to an underground conveyor which delivers

FIGS. 8 AND 9.—*Views in the Apprentice School: Tapping of the Tilting Furnace; and Apprentices preparing Moulds.*



the sand to the main preparation plant. Most of the work here is made in moulding boxes and, when finished, cored-up and closed, the moulds are poured *in situ*. Two large mould-drying stoves serve the bay and for the finishing of castings there is a fettling section and a large Tilghman shot-blast machine.

Number Four Bay

No. 4 bay houses the coremaking department with its own sand-preparing plant, and ten drying stoves of the bogie type together with an Acme vertical continuous drying-stove situated halfway along the bay. The stove is used for the smaller cores which are fed to it on a steel-band conveyor running between the benches of the coremakers, who are supplied with prepared sand by a pendulum bucket conveyor. Larger cores are transported by truck to bogie-type stoves which are arranged in two groups of five, each group serving one half of the department. Here the cores are dried overnight, preparatory to being stored for use.

Cores are conveyed to the moulders on petrol-driven trucks, which are able to deliver loads right up to the position required, since they are able to run almost anywhere on the concrete floor. For movement between the bays, rubber-wheeled hand-trucks are used for light work, while bogies carry the heavier cores.

Non-ferrous Foundry

Non-ferrous castings used on the engines are produced in a separate department which occupies the end of No. 4 bay and here, as throughout the foundry, the highest class of work is turned out. In addition to ordinary brass castings, many other metals are cast in this section including gunmetal, phosphor-bronze, aluminium-bronze and high-tensile manganese-bronze. Aluminium and kindred alloy castings are other products of this department.

The melting units, of which there are six, are 200-lb. coke-fired Morgan furnaces, arranged below ground level. The air blast for each is supplied by an electric-motor-driven blower. Crucibles of metal are lifted from the furnace and carried to the place where they are required for pouring, the metal being run directly from the crucible.

An electricity sub-station and air compressors are situated at the north end of the foundry in buildings adjacent to the main structure and a blast house, with Rootes blowers to provide blast for the cupolas, is also built at this end of the foundry.

Total production of dressed castings is of the order of 135 tons per week.

Apprentice School

Apprentices, before passing into the foundry proper, are taught their trade in a well-equipped school. Here they learn how to mix sand, and make moulds and cores. From results obtained they are able to study correct methods of running and casting. The school is provided with its own sand-mill and drying-stoves, and an oil-fired Morgan tilting furnace, similar to that used for alloy melting in the main foundry, is used as a melting unit. Demonstration classrooms are included in the building and here instructional films are shown. It will be appreciated that this attention to instruction pays large dividends in the higher skill of the apprentices when they pass on to production work. Figs. 8 and 9 show boys at work in this section.

FIG. 10.—*View of the Large Patternshop which supplies High-grade Patterns for the Foundry.*

FIG. 11.—*A Corner of the Crossley Canteen during a Lunch-hour Break.*

Patternshop

Separated from the main 210 by 110-ft. foundry by the entrance road and stockyard, another large building houses the patternshop (Fig. 10). Here a high degree of patternmaking skill, aided by the use of modern machinery, ensures that patterns of the quality required for engine castings are turned out. Working conditions in this shop are enhanced by the spacious layout. Foundry administration is carried out from offices in the patternshop building.

Amenities

At the same end of the foundry as the school, *i.e.*, the north end, are situated washing and other amenities for the foundry-workers. Female employees are provided with bathrooms and footbaths and male workers have showerbaths and baths at their disposal. These rooms are both attractive and hygienic, with terrazzo floors and tiled walls, and their facilities have been much appreciated.

A spacious and comfortable canteen (Fig. 11), also in the same building as the patternshop, provides meals for the employees. For entertainments, the canteen possesses a stage, complete with dressing rooms. Evening concerts are a feature of the social activities during the winter. The floor can quickly be cleared for dancing and a programme of regular dances has proved very popular.

The aim of this modern foundry is to ensure, by the best possible use of skilled labour, modern production methods and up-to-date equipment, that the castings produced will help to maintain the reputation of the company among the leaders of the internal-combustion-engine industry.

OWING to the low prices being paid, Warwickshire farmers have decided against taking part in the Midland drive for scrap. Organisers of the drive regret the loss of the potentially-valuable metal scrap in the agricultural areas of the county.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

CAST-IRON CRANKSHAFTS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—As one who has been closely concerned with the development of cast-iron crankshafts, and who is responsible for the majority of such shafts made in this country to-day, I have read Dr. Everest's Paper in the issue of December 6, 1951, with the greatest interest.

I do, however, think that he had attached too much importance to notch-sensitivity and shock-resistance for crankshaft material. In the early stages, we also were of the opinion that minimum sensitivity to notch effect was important, but our subsequent experience confirms the work of the Motor Industry Research Association which shows that notch-sensitivity has not the influence Dr. Everest ascribes to it.

In the work carried out by M.I.R.A. the bending-fatigue strength of test-bars of acicular iron was almost unaffected by a sharp V notch, and that of a high-duty iron was reduced by 22 per cent.—still a small loss by comparison with steel, but the ratio of the bending fatigue of actual crankshaft strength to the fatigue strength of the material was 0.42 in both cast irons, a ratio comparable to that shown by steel. The 0.05-in. radius groove, which is used as a measure of notch sensitivity in the tests reported by Dr. Everest, is (assuming 0.3-in. dia. specimens) proportionately less sharp than the normal crankshaft bearing fillet, and would in practice be regarded as a very generous radius. The size of the fillet radius has a very great influence on the fatigue strength of a crankshaft, and both forged-steel and cast-iron shafts are affected to the same degree.

The point I would emphasize is that fatigue strength is the most important requirement of a crankshaft material, and the only property which can be co-related with practical results. The M.I.R.A. tests of the bending-fatigue strength of the bars cut from identical crankshaft castings showed ± 9 tons per sq. in. for Meehanite and ± 10 tons for acicular cast irons. The indication from Dr. Everest's Paper is that spheroidal-graphite cast iron will show little improvement on these figures even when allowance is made for the probably increased fatigue-strength of this material with a pearlitic structure.

In order to widen the sphere of application of cast-iron crankshafts, it is essential that the bending-fatigue strength be raised, and it is disappointing that the new material is not expected to have a significantly higher endurance limit than the high-duty iron which is in daily production by my own company for crankshafts.

I wonder whether Dr. Everest can explain why the new material shows so little advantage in this vital respect and suggest what steps can be taken to improve the fatigue strength.—Yours, etc.,

J. F. CHAMBERS.

Qualcast (Ealing Park), Limited,
South Ealing, London, W.5.
January 3, 1952.

THE PAKISTAN GOVERNMENT has requested a copy of a film of production made in the large steel foundry of F. H. Lloyd & Company, Limited, at Wednesbury, for showing at the second Pakistan International Industries Fair at Karachi from March 1 to April 6. The film aroused great interest when it was shown to Wednesbury cinema-goers recently, and it has since been seen by audiences in many parts of Europe and other cities in the world.

Designing Components for Die-casting*

By W. M. Halliday

Whilst the points enumerated in this article are by no means exhaustive, the chief factors to be considered when designing a component for die-casting, such as, sectional thickness of component; uniformity; parting lines; coring methods; threaded and plain holes; taper or draft; dimensional tolerances and flash formation and removal have been dealt with in detail. General guidance is given as to the manner in which design may be interpreted and adjusted to give the most suitable form for die-casting, coupled with minimum cost of dies and parts.

Features to be Employed

Having satisfactorily determined the kind of alloy, the character of the physical properties required in a casting, and the particular die-casting process to be adopted, the next steps to consider are the precise kind of features, forms and shapes, which may be incorporated in the die-cast part. Amongst these are the permissible or most-suitable wall-thickness; the disposition of parting lines in the die and their influence upon the accuracy and surface finish of the component; the quality of surface finish obtainable; the dimensional accuracy possible; the coring of holes, openings, and internal formations; the degree of taper on side-walls, holes, etc.; the feasibility of casting threads (internal or external); the degree of flash formation from parting lines, ejectors, etc., with ensuing trimming operations and their costs; how inserts may be employed for casting in position, and so forth.

Each of these features will have some (and often considerable) influence upon the general applicability of the component design in so far as it may be produced economically, either as a gravity or pressure die-casting. They will also affect the design, construction, and use of the die, its cost and that of the component, and the rate of output possible.

Wall Thickness

One of the characteristic advantages possessed by the die-casting processes is that, within specified limits, wall section and thickness can often be adapted to obtain the maximum strength and rigidity coupled with minimum weight. With die-castings, more so than with articles produced by almost any other metal-forming process, there can be achieved the most efficient distribution of wall-section, shape and thickness in relation to strength and weight considerations. In practice, with the general run of die-castings, stressing will be low or of a moderate order. This will mean that the thinnest wall-section may often be employed without any sacrifice in the strength, rigidity, or durability of the component in comparison with its service needs, or an article made by some other method. Thus not only will the actual material costs be kept at a minimum, but very often a more pleasing appearance will be achieved.

Additional advantages may also accrue from the use of thin walls. For example, in any die-casting, because the thinnest walls will chill and solidify in the cavity far more quickly than thick, a speedier operating cycle may result. The casting also may be ejected more rapidly and with greater safety than is the case with a thick-walled component. The casting will be more than proportionately stronger. External surfaces will be likely to be much smoother and relatively free from blemishes such as blisters, surface sinks, caved-in spots, cracks and so on. The internal structure of its thin walls will also be sounder and less liable to porosity.

Porosity can arise from unequal contraction forces—a defect largely unavoidable when massive sections are employed. Thick wall-sections also necessitate the die being operated at a much higher working temperature than is necessary with thin-walled components. This will mean the hot alloy in close contact with such overheated die-cavity surfaces may be subject to surface "checking," which feature will constitute a disfigurement of the appearance. Surface checking of this kind rarely occurs with lower-melting-point alloys, but very often causes troubles when the higher-melting alloys are used, such as aluminium and copper-base. Table I should be found useful as a general guide to the *minimum* wall thickness to be employed with various alloys. Zinc-base alloys having walls as thin as 0.015 in. have been successfully pressure cast, but the values given in the Table will be found more generally applicable, and certainly will be attainable with least difficulty.

* An earlier contribution by this Author, "Selecting Components for Die-casting," printed in the March 15, 1951, issue is complementary to the present article.

TABLE I.—*Maximum Weight, and Minimum Wall-thickness Generally Applicable for Die-castings in Various Alloys.**

Casting alloy.	Tin-base.	Lead-base.	Zinc-base.	Aluminium.	Magnesium.	Copper.
Approximate max. weight of casting in lb. ..	8	18	32	15	8	8
Min. wall-thickness on small castings (in.) ..	0.030	0.035	0.020	0.055	0.050	0.050
Min. wall-thickness on large castings (in.) ..	0.060	0.065	0.050	0.085	0.080	0.100

* These are empirical values only, and will depend upon design features, and conditions. In the case of tin and zinc-base alloys, with special precautions thinner wall sections can often successfully be die-cast.

Designing Components for Die-casting

Where extremely thin walls, *i.e.*, those below 0.020 in. are specified, certain objections may arise when casting due to the excessive restriction offered by such narrow cavity spaces, and special precautions will usually have to be adopted. With the higher-melting-point alloys it is rarely desirable or economical from both casting and die design angles, to employ walls thinner than the values listed, even with components of the smallest size and surface area.

It will also be observed that Table I gives no specific *maximum* values for wall-thickness. Die-castings have been successfully cast with walls as thick as 1½ in. and relatively free from porosity, but in production practice, walls above about ½ in. thick are rarely used or recommended in order to avoid added cost and care required to produce thicker sections successfully. The wall thickness of any gravity die-casting will have to be somewhat greater than that for the same component produced in a comparable alloy as a pressure casting, because the flow in the former process depends wholly upon gravitational pressures.

Uniform Thickness

With both gravity and pressure die-castings, the degree of uniformity of the wall-section is almost as important as the selection of the thickness used. Sudden or large transitions from very-thin to thick sections are always to be avoided. Ample blending fillets, or curves, or a gradual tapering-off from thick to thin portions, should always be specified to avoid sudden interruptions in wall section.

Thin walls, which chill and solidify first, if joined abruptly to thick portions, will tend to warp, or even fracture by cracking, as a result of their inability to resist the more powerful contraction forces arising when the thicker masses cool and solidify. Such cracks or excessive warpage will usually occur at the point where the thick and thin portions join, and will result in a weakened casting. The greater the variation in wall thicknesses, the greater will be the disparity between their shrinkage rates and effects, thus the increased liability towards the faults mentioned earlier. This is of some seriousness, especially with a few of the high-melting-point alloys which are prone to "hot-shortness." When thick and thin wall sections are unavoidable, the largest radius fillets should be specified for joining them. Alternatively, the advisability of reducing the amount of metal in the thick wall by coring-out shallow recesses should be considered. Very often, this may be accomplished without drastic alteration in design, especially when such recesses can be situated on an internal surface of the article. A further common expedient adopted is to introduce ribs, locating them upon some internal wall of the component, and which may be formed simply by channelling the raised core in the die.

When considering this important matter of wall thickness and uniformity applicable to a casting, it will always be essential to remember that strength is not wholly or directly determined by wall thickness alone. For die-castings (especially those having intricate configuration), bosses, beads, flutes, ribs, fillets, ledges and similar stiffening features can often be advantageously employed to ensure greater uniformity of wall section and minimum thickness at certain points, without detracting from the resultant strength or rigidity.

Parting Line Disposition

The manner in which the cavities, etc., and the parting-line surfaces are situated in a die is a matter usually arranged by the die designer. Nevertheless, it will prove extremely useful if the component designer is able to envisage how the die will need to be parted and exactly where such partings will occur in respect of the component. This will be helpful in two respects. First, it may lead to valuable simplification in the shape or form of the proposed casting, to enable the die to be parted preferably along a single straight plane, instead of with an irregular plane. Secondly, it will enable the component designer to foresee at which points the greatest dimensional variations or inaccuracies are liable to occur, and where parting-line flash will be situated.

A die-casting die normally has to be parted along the line of the greatest dimension of the component to avoid undercuts in a cavity portion, and difficulty in ejecting the casting from the die. Irregular, inclined, stepped or curved die-partings are of course feasible, practicable, and often necessary. The chief drawbacks associated with their use, however, are:—(*a*) The higher cost of their reproduction in comparison with simple straight-line partings; (*b*) the greater difficulty in ensuring a close seal when the die is closed, and (*c*) the added risk of producing unduly-thick flash at some point along the parting line.

It has to be remembered that it is not always simple or inexpensive to remove flashings formed along an irregular parting line without leaving some unsightly scar or roughness. The parting line should be disposed to ensure the simplest, safest, and quickest form of ejection of the component from the die, combined with the simplest form of construction. This is of lesser importance with dies for gravity work. With pressure dies, however, considerable assistance may be afforded the die designer by allowing some freedom to modify component shapes and designs to meet requirements of this kind.

If the shape of a part is such to necessitate an irregular or awkwardly-disposed parting, the die may have to be of the built-up construction comprising numerous sub-blocks. This in turn will usually mean a higher cost than if a "solid" die-block construction were employed. The joints of such die sections will also be a source of flash.

Coring

Many advantages may be gained by judiciously coring-out a die-cast component, as for example: The total cost of a component may often be reduced due to smaller amount of material required; holes, recesses, slots, and openings, etc., can be formed to close limits of accuracy in size and location; sections of the component wall may be maintained more uniform in thickness and even in shape; sounder and

stronger castings will be produced; coring often enables a more homogeneous wall-structure to be obtained; faster working of the die may be accomplished; die design, manufacture, and setting operations will often be considerably simplified and costs reduced, and economies may also be achieved by coring to eliminate subsequent machining, tapping, assembling of fastening devices, or other operations.

Cored holes may be formed for almost any shape provided there is no *undercut* portion at any point throughout the length of the hole which would prevent the finished casting being readily drawn-off its core in a direction *co-axial* with that of the die element.

Threaded Holes

By the provision of threaded core-plugs so mounted in the die as to be capable of unscrewing out of the finished casting, threaded holes may be reproduced with great facility, always providing that the pitch of threads is not too fine, i.e., having no more than about 26 threads per in. with zinc-base alloys, and about 16 for aluminium or magnesium alloys, and where the diameter of hole is not too small. With pressure die-castings, threaded cores of the above kind are mounted so as to be rotatable in a die-block, and are usually mechanically unscrewed by means of gears, racks, or similar mechanism acting in concert with the normal opening movement of the die-blocks.

In the case of gravity dies, however, threaded cores generally have to be ejected with the finished casting and thereafter unscrewed by hand operation. For this reason it will be appreciated that some slowing down of production will result. This is important to remember, because the stipulation of a number of cored and threaded holes in a proposed gravity die-casting might easily result in such a reduced rate of production as would render it uneconomical to core such holes at all. Keyways, splines, or longitudinal slots may, also be most conveniently cored along the sides of a hole, providing always suitably raised projections can be formed integrally, or securely mounted upon, the sides of the core.

Similarly, spigots, male or female can be cored to very close tolerances of dimensional variation, and with very little ovalness, so as to require no further machining. This is a point very frequently overlooked by a component designer accustomed or trained to regard fine tolerances as achievable only by machining.

In the successful reproduction of cored holes in a gravity or pressure die-casting, it is important to provide some degree of taper on the sides of the holes and the steel cores used in the die. This is known technically as "ejection draft" and is required with both forms of casting to facilitate ejection of the finished part. As a general rule, the draft on holes and cores is made approximately ½ deg. per side in the case of pressure castings and from 1 to 1½ deg. per side with components formed by the gravity process. These of course are to be regarded as minimum values only, and, where circumstances permit, greater taper should always be allowed.

Ejection Draft

Gravity die-castings require a greater amount of such ejection draft owing to the fact that with the higher-melting-point alloys there is always considerable shrinkage upon solidification, and thus a more powerful "bite" on cores, and also because the cores have usually to be extracted manually. With pressure die-castings, however, the magnitude of shrinkage is much less, and mechanical pressure is nearly always available on the machine for moving such cores. Moreover, with many types of pressure die-castings made in zinc-base alloy, it will be possibe to core holes by means of sliding or rotable cores, which latter may be drawn out of the casting almost immediately after injection and certainly before the die has been opened to effect normal ejection of the part. In such circumstances a smaller amount of ejection draft is permissible. Nothwithstanding this, it is always advisable to stipulate the maximum amount of taper on all holes, in order to reduce the ejection pressures required to remove a casting, especially where the part is extensively cored at large diameter or to great depth.

With castings having thin wall-sections, or delicate unsupported portions which are liable to distort during the actual ejection operation, the degree of taper on cores may be of critical importance. When a large degree of taper can be permitted, fewer ejector rods, or, alternatively, rods of smaller diameter may be employed, owing to the reduced pressure needed to remove the casting. This in turn will often simplify die-design by allowing ejector rods to be disposed at more convenient points on the casting surface, and will also tend to reduce die costs

Where precision-type die-castings have to be pressure cast to strict dimensional tolerances a measure of taper on holes will similarly be of great importance by affording simpler and safer means for ejection and avoiding distortion of the article when the ejector rods come into action. Table II gives the *minimum* amount of ejection draft to be employed on castings in different die-

TABLE II.—*Minimum Ejection Draft or Taper on Side-walls and Cored-holes for Die-casting.**

Casting alloy.	Tin-base.	Lead-base.	Zinc-base.	Aluminium.	Magnesium.	Copper.
Taper on sides of casting per in. of length or dia.	0.002 in.	0.003 in.	0.003 to 0.005 in.	0.008 to 0.010 in.	0.008 to 0.012 in.	0.015 to 0.020 in.
Taper on sides of holes per in. of length or dia.	0.002 in. ½ deg.	0.003 in. ½ deg.	0.003 in. ½ deg.	0.012 to 0.015 in. 1 to 1½ deg.	0.010 to 0.015 in. 1 to 1½ deg.	0.020 in. 1 to 1½ deg.

* Values are approximate and only generally applicable according to design of component, and degree of accuracy required on critical hole-diameters. With low-melting-point alloys, smaller taper can often be used successfully, especially where holes are short.

casting alloys. It will be understood that this taper on core-plugs etc. has to be applied in a particular manner, *i.e.*, with the maximum diameter or greatest cross-sectional dimension of the hole always lying at the parting line surface of the die.

In special cases and with certain types of casting, the die-caster may have to employ a slight negative or reverse form of taper on cores to ensure the finished component will always adhere to the movable die-block, a feature which will often greatly simplify ejection. Provision of such reverse taper however should always be left to the discretion of the die designer.

Size of Cored Holes

Very small holes may be cored, particularly with the lower-melting-point alloys, *e.g.*, 0.030 in. dia., but this will only be practicable or economical where the length of such hole is relatively short, or where the hole has to extend clean through a wall-section, so enabling the core-plug to be supported in a guiding hole in the opposite die block. Coring of holes less than about 0.050 in. dia. is rarely advisable with the higher-melting-point alloys, however, owing to the high strains inflicted on the core during ejection, and the liability to chemical attack, which of course would speedily destroy the shape and smoothness of such slender elements.

When determining the size of a cored hole in a proposed casting, it is essential to bear in mind that cores mounted in a die have to be very strong, sturdy and rigid, capable of resisting deflection, breaking, or burning caused by forcible impact of the alloy charge during injection or pouring. The length of hole which can safely be cored-out is to a large extent conditional upon the diameter, ranging in practice from 4 to 8 times the diameter. Supported cores in a die, *i.e.*, those which are guided within a supporting hole in the opposed die-block, have the greatest degree of stiffness and strength, and for that reason the length of hole can often be increased beyond the proportions just given.

Types of Cores Used

According to the design features required in a cored component, one of four different types of core may have to be used. These are:—(*a*) Fixed core; (*b*) movable core; (*c*) interlocking core, and (*d*) collapsible core. The first kind (*a*) is the simplest and cheapest to construct and use, and usually consists of a cylindrical rod fixed in one die-block. However, this form of core can only be employed where the hole is located at right-angles to the die-parting, and axially in alignment with the direction of opening movement. The component has to be stripped off such a fixed core by sleeves, rods, or other common devices. Undercut portions in a hole cannot be formed at all by means of this solid, fixed-type of core.

Movable cores (*b*) may be employed where the axis of the hole is inclined to the die-parting surfaces, in which case it will be mounted in a slide or a bearing within which it may revolve, being actuated at some point in advance of the normal opening of the die. Movable cores may slide, rotate, rock, or screw within a die, and generally will have to be operated prior to the ejection of the component.

Interlocking cores (*c*) will be employed when holes have to be formed with the axis lying in two planes. These die elements are frequently very difficult and costly to produce in the first place, and may entail operating troubles and increased maintenance attention. Their use may also lead to excessive flash formation within the cored hole, such flash being situated at the point where the two cores interlock or mesh with each other. Removal of such flash from locations difficult of access may prove protracted and costly, and this point should always be carefully considered by the component designer when contemplating use of a hole, the axis of which lies along different planes.

Collapsible cores (*d*) are restricted chiefly for use with gravity-type dies, although in certain circumstances they may be advantageously employed with pressure dies. The chief reasons why they are so rarely used with the latter tools are the greatly increased die-making costs, the slower working speed of the die, and increased tendency towards flash formation. Collapsible or sectional cores are, however, often of the greatest utility with gravity dies, since they may be very easily stripped from the cast component after it has been withdrawn from the main die-cavity. By using collapsible cores capable of manual actuation, gravity die-castings may be produced having holes extensively undercut at the sides, in a manner not always practicable with pressure die-castings. The degree of dimensional accuracy attainable with collapsible cores, however, is apt to be considerably less than that obtained by using a solid core-plug, and when specifying holes requiring cores of the former kind, the component designer will do well to bear in mind this possible loss of precision on critical dimensions.

Destructible sand cores are also often employed to great advantage with gravity dies for producing undercuts, chambers, slots, and like features in the side of a cored hole. Sand cores should not be used with the pressure-die-casting process.

Taper on External Walls

External side-walls of a die-cast component should preferably possess a slight degree of taper to facilitate ejection, but this taper will normally be very much smaller than that provided on cores for producing internal formations on the part. Normally the solidifying component will tend to shrink away from the walls of the die cavity, except in cases where large cores, etc., arrest such movement.

A wall taper of approximately 0.003 to 0.005 in. per in. of wall length will usually be found sufficient with pressure die-castings, and from 0.008 to 0.020 in. per in. for gravity die-castings. Again, these are to be regarded as minimum values, and often where this taper can be increased some practical benefits will be derived towards simplifying ejection, reducing distortion, and speeding-up the die-casting cycle. As with core elements in the die, such taper should

be arranged to give the largest dimension of the die cavity at the parting-line plane so that undercuts will be avoided.

Thread Casting

The component designer will very often have to consider the feasibility of producing die-cast threads on an article. In general, very good threads can be die-cast internally or externally in the lower-melting-point alloys, where the pitch and diameter of hole are within suitable limits indicated previously. Internally-threaded holes are not so readily produced in the higher-melting-point alloys, however, and because of certain practical disadvantages are not recommended, except in those instances where machining and tapping of holes would entail great expense. Table III gives the maximum number of threads per inch, external or internal, advisable with various alloys. These values will often be influenced, however, greatly by the general design features embodied in the components, especially those relating to hole diameter, thread-form used, accuracy required, and length of such threaded portions. The values in Table III are also based upon the minimum hole diameters given earlier.

Coarse-pitch threads situated externally can be reproduced most economically, especially when pressure-die-cast in the lower-melting-point materials. In such cases, hollow cores and the like can usually be arranged for speedy mechanical operation derived automatically from the machine motions, or the normal opening and closing movements of the die itself. Thus, as the die is opened prior to ejection, the thread core will be unscrewed the correct distance off the casting form to allow the component to be ejected from the die in the usual manner by the ejector rods. With gravity die-castings, threaded core-plugs will usually have to be mounted in the die in such a manner that these members will be ejected with the casting and later unscrewed as a separate operation. To facilitate production and minimise delays, it is customary to provide a number of identical core-plugs interchangeable in the die so that the tool may be kept in continuous operation.

Split-thread Cores

Care should be taken where possible when specifying cast threads to guard against using those forms requiring a split type of core, or similar formation in the die. This may cause additional undesirable flash along the length of the threaded portion, and its removal will involve chasing the threads to cut the flash away and bring the threads to the necessary accuracy in pitch, diameter, and form. Threads formed by split cores, etc., are always prone to some degree of ovalness, and must always be machined when close accuracy is required. The thread form is also of some importance especially with the higher-melting-point alloys. Rounded crests and roots should be used wherever possible because, where the cast thread has sharp-pointed crests and roots, the steel core-plug will similarly be formed with a series of sharp edges. These, when casting aluminium, magnesium and copper alloys will thus be subjected to considerable strain and to some chemical action from the molten alloy injected. As a result, the sharp edges may speedily break down, or become " heat-checked " to such an extent as to destroy the appearance and smoothness of the threads, and in course of time make the die-cast threads shallower in depth.

This is also one of the reasons why fine-pitch threads cannot be reliably die-cast. Another reason is that the high-melting-point alloys shrink to a far greater extent upon cooling, and if the crests and roots of fine-pitch threads have become eroded, increased difficulties will attend the ejection of the component. Since contraction effects on the cooling casting will occur in *all* directions, *i.e.*, along the length as well as across the diameter, considerable errors in pitch spacing of the teeth may occur with long threaded portions.

Special Threads

It is possible, of course, for the die-maker to form the threads on the cores of the die, with pitch compensation to accommodate such shrinkage effects, but this will nearly always add very considerably to die costs, and very often will prove prohibitive if the component can be easily machined on the threads by passing down a chasing or sizing die. Where this is required it will be advisable to cast the threads slightly oversize in width, and shallow in depth to afford sufficient allowance for such an operation.

Cast threads can also be extended right up to an enlarged shoulder of a component, or in the case of blind holes, down to the very bottom of the hole, in a manner not practicable by any machining process. In some instances, this will prove of some advantage by saving material and enabling a shorter component or thinner wall-section to be employed. Threads of an unusual shape, and non-standard pitch can of course be readily cast, providing it is possible to make up the necessary die cores in a sufficiently inexpensive manner.

Threads may be die-cast in situations on the casting in a way not easily practicable by any other process of manufacture. Thus an external thread

TABLE III.—*Minimum Diameters of Cored-holes and Maximum Number of Threads to be Cast in Various Alloys.**

Casting alloy.	Tin-base.	Lead-base.	Zinc-base.	Aluminium.	Magnesium.	Copper.
Min. dia. of cored-holes (in.)	0.030	0.035	0.030	0.085	0.090	0.120
Max. number of ext. threads per in.	30	32	26	20	20	10
Max. number of int. threads per in.	30	32	24	None	None	None

* Feasibility of casting external and internal threads, pitch accuracy, etc., depend upon thread form, length of hole in relation to diameter and whether the component is split across the threaded portions. Hole diameters will depend to some extent on whether the core in the die is unsupported at one end, and on the length of the hole. The ratio between hole diameter and length should preferably be kept as small as possible.

may be formed on a sunken boss or shoulder of a part, inaccessible to the customary screwing methods. Tapered-thread portions may also be satisfactorily die-cast, especially by the pressure method, again in a way which will show useful savings.

Dimensional Accuracy

The accuracy and uniformity of shape and size attainable with a die-casting will often be of paramount importance to the component designer, by reason of the great economies ensured by due precision in these respects. The degree of dimensional accuracy will be dependent upon a number of closely inter-related factors, of which at least the more prominent the component designer should be aware and understand in their relation to each other and the precision qualities sought. Some of the chief factors controlling the degree of precision are:—(*a*) Alloy used, and its melting temperature; (*b*) actual shrinkage occurring for the alloy; (*c*) the form of die construction employed, especially with regard to location of parting-planes and joints, form and mounting of cores, method of ejection, operating mechanisms, position of inserts, etc.; (*d*) position of gates, runners, and in the case of gravity dies, the riser channels; (*e*) magnitude of "ejection draft" provided on all cores and cavity walls; (*f*) quality and accuracy of the important gravity formations machined in the die; (*i*) manner of ejection, particularly the length of time allowable between injection, pouring and final removal of the part from the die, and (*j*) the soundness or homogeniety of the walls of the casting, and their freedom from porosity, distortion, or other serious irregularities occurring with die-castings.

Causes of Inaccuracies

Most of these factors will have to be considered in connection with a proposed pressure die-casting, but with gravity-process castings not all of these will operate to affect dimensional accuracy. Incorrect die closure, either with pressure- or gravity-type tools, caused by adhesions of particles of metal between joints, intersections, core bearings, or main parting line surfaces of the die, will often result in the loss of accuracy, or the production of undesirable ovalness in respect of some cylindrical type of casting made from an axially-jointed die.

Locking devices and mechanisms required for locating and fastening movable cores may cause some wear at one side of that member, and resultant displacement from the true axial position, which error will be faithfully transmitted to the casting by a similar displacement in the position of an important hole. The finished casting may be unduly distorted during the actual ejection stage, due to the incorrect disposition of ejector rods, lack of ejection draft on cores, or to the development of excessive contraction grip of the part on to its cores.

Because of the general design features of a casting, the part may have to remain on the cores for an excessive amount of time after pouring, or injection as the case may be. This factor is often one of the main causes for variations occurring in dimensional accuracy and uniformity with successively-produced parts. Whilst most of these factors will be directly the concern of the die designer, those listed alphabetically should at least be considered by the component designer proposing to use a die-casting, and as far as possible he should endeavour to determine in what degree they are likely to arise and affect accuracy.

Tolerances given in Table IV covering the various die-casting alloys, take into consideration most of the above-mentioned factors with the exception of those resulting from distortion, and thus are representative of the dimensional accuracy to be expected in normal production, and not just with the initial samples produced from a new die. Before specifying any tolerances on critical dimensions of the proposed die-casting, it will always be advisable to discuss the subject fully with the die-designer, before the design is completed. If the advice thus given is adopted, the design of a component may often be materially modified in some respect to enable the die to be "run" or constructed in another manner more conducive to accuracy in the part in the "as-cast" condition.

Generally, it may be assumed that the low-melting-point alloys can be pressure cast with closer precision and uniformity than gravity die-castings. Tin-base alloys, especially where the castings are small, are perhaps the best in this regard. Pressure-die-cast zinc-base alloys are perhaps the next best in the order of precision and, where the dimensions are not intersected by a joint of parting plane, can be held to plus or minus 0.001 in. per inch of dimension. Aluminium and magnesium alloys closely approximate to the zinc-base alloys when pressure die-cast on the score of dimensional accuracy, but as indicated in Table IV must have greater allowances when produced as gravity die-castings because of the additional contraction, and the need for greater ejection draft. The greater the tolerance allowed on the component drawing, the

TABLE IV.—*Accuracy on Component Dimensions and Tolerances Attainable in Different Die-casting Alloys.**

Casting alloy.	Tin-base.	Lead-base.	Zinc-base.	Aluminium.	Magnesium.	Copper.
Tolerances when component dimension is produced wholly from cavity in one die-block (in. per in.)	Plus or minus 0.001	Plus or minus 0.002	Plus or minus 0.001	Plus or minus 0.002	Plus or minus 0.003	Plus or minus 0.003
Tolerance when component dimension is axially split, formed by two mating cavity formations (in. per in.)	Plus or minus 0.002	Plus or minus 0.003	Plus or minus 0.002	Plus or minus 0.003	Plus or minus 0.004	Plus or minus 0.004

* The above values depend largely upon the accuracy of the die construction, its design, and certain operating conditions. When a critical component dimension is formed from two mating cavity portions, contained one in each of the die-blocks, greater tolerances must be specified as in the lower column to allow for ovalness, parting-line flash, and off-setting.

simpler it will be for the die-caster to hold the casting to such dimensions, and despite the fact that die-casting is an extremely accurate process, unnecessary precision should be scrupulously avoided.

Flash Formation and Removal

Some degree of flash is practically unavoidable with any kind of die-casting, though usually good pressure castings will be relatively free, and any flash occurring thereon should consist of a very thin fin, except at the gate location. Gravity die-castings, however, may have quite considerable flash, especially when regarding risers, runners and gates in that category, as in reality they are when judging the appearance value of the part. Flash, with both pressure and gravity dies, tends to increase over a period of time due to slight wear taking place on critical die surfaces. This wear, particularly with dies used on the higher-melting-point alloys will take place at sharp corners, knife-edge joints, etc. Provision has to be made for flash removal from all castings; this often entails the use of special shearing or trimming tools, the cost of which will be chargeable to the user. Therefore, on the grounds of economy when developing a component design, some attention should be given to the possibilities of flash formation, as to where unavoidable flash will be located, and how simply it may be removed.

This can be achieved by observing the following rules:—(1) Ensuring that the number of joints, intersections and partings required in the die construction will be as low as possible; (2) maintaining flash lines as short as practicable and preferably along one plane; (3) locating the flash line upon flat, geometrically regular surfaces; (4) limiting the use of slides, movable cores, collapsible cores, or an excessive number of ejectors to the essential minimum required to produce the casting; (5) for preference to locate the flash at some sharp edge, or crest of a rib or beading, so as to facilitate its removal; (6) where portions of a die-casting must be machined, an attempt should be made to localise flash at that point; (7) not to have a flash line occurring on a large flat plain surface as this may entail difficulties when trimming and some damage to the as-cast flat surfaces adjoining the flash line as the part is passed through a trimming die; (8) keep ejector rods as small in diameter and few in number as practicable, and ensure that they impinge upon some inside and unimportant surface where flash will be of less consequence; (9) endeavour to gate the cavity upon some unimportant edge of the component to permit waste sprue, etc., to be finished-off easily; (10) flash removal is greatly facilitated by avoiding grilles, serrations, notches, undercuts, etc., at the point where a flash line has to be expected, and (11) keep the contours of large, flat components as regular as possible to permit easy removal of rim flashings.

Whilst the die designer will often be able to offer useful advice to avoid many of the troubles arising from flash, it will often be of the greatest help and economy if at the originating stages the component designer is able to visualise the liability of any design to the faults enumerated.

Shipbuilding Needs More Steel

British shipbuilders require 50 per cent. more steel than their current deliveries if all-out economical production utilizing existing capacity and manpower is to be maintained, it was stated by Mr. J. Ramsay Gebbie, president of the Shipbuilding Conference, in a New Year message. The final figures for the period up to the end of 1951 revealed that there was a record shipbuilding order book of over 1,100 ships totalling 6,500,000 gross tons and valued at about £600,000,000 at current prices including £200,000,000 for direct export. The current order books contain a high proportion of dollar contracts.

The output of British shipyards in 1951 was about 1,400,000 gross tons, closely comparable with the annual output of the last three years, but the inflow of orders in 1951, Mr. Gebbie observed, at 4,000,000 gross tons, was almost 10 times the total for 1949. This was largely due to the abnormal international situation, the maintenance of high freight rates, and the still growing world demand for oil. The latter would no doubt explain why tankers represent about 55 per cent. of the ships on order. In spite of this, not all yards were full up for four years ahead and reasonable early deliveries could be offered for many types other than tankers, conditional on an increased supply of steel.

Welcome Arrival

Due to arrive on the Clyde is a ship that will be welcomed with open arms by Lanarkshire steel manufacturers. She is the British India Steam Navigation Company's liner Khandalla (7,018 tons). Built on the Tyne 22 years ago, she has been running between India and East Africa. Now after many years of service in the East she is making her last voyage, which will end when she ties-up alongside the shipbreaking yard of Arnott, Young & Company, Limited, at Dalmuir.

Her hull and superstructure will produce thousands of tons of badly-needed scrap for Lanarkshire and other local steel foundries, where the shortage of scrap has forced some foundries to cut production. With the price of new ships and ship tonnage in use higher than ever, most shipowners are hanging on to their old vessels or selling them to foreign owners who are paying high prices for ships that in normal times would have gone for scrap. This has aggravated the shortage of scrap and the industry suffered a bad blow when the Brazilian battleship Sao Paulo disappeared on her way to the Clyde for breaking-up.

To Study U.S. Plant Maintenance

A British team of nine members sailed in the "Queen Mary" last week to study plant maintenance in the United States, under the auspices of the Anglo-American Council on Productivity. The team includes Mr. J. B. Stevenson, works director of the Electric & Musical Industries Factories, Limited, and Mr. G. C. Allfrey, director of Ordnance Factories (Engineering), representing the Ministry of Supply.

The rest of the party is made up of an industrial consultant, a chief engineer, a plant engineer in charge of oil refineries, a member of the executive council of the Amalgamated Engineering Union, a works engineer, and a foreman.

Latest Foundry Statistics. The output of copper-base castings during November was 6,776 tons and during the first eleven months of 1951, 61,218 tons, as against 41,747 during the same period of 1950.

New Year Honours

In addition to those published last week, the following names of people associated with the foundry, iron and steel, and allied industries are contained in the New Year Honours List.

ORDER OF THE BRITISH EMPIRE

M.B.E.

G. HARROLD, manager, oil tank cleaning department, Grayson, Rollo & Clover Docks, Limited, Liverpool; W. C. HOLDEN, manager, variable speed gear production department, Vickers-Armstrongs, Limited, Newcastle-upon-Tyne; MRS. E. E. JONES, secretary, Mersey Shiprepairers' Federation; H. JOYNES, works manager, Stafford Salt Works, Imperial Chemical Industries, Limited; J. LEE, manager, open top factory, Metal Box Company, Limited, Neath; N. McL. McCAIG, director and chief engineer, Fisher & Ludlow, Limited, manufacturers of pressings, etc., of Birmingham; W. McDOUGALL, head foreman turner, John Hastie & Company, Limited, makers of ships' steering gear, of Greenock; M. ST. C. MARSHALL, director and general manager, Marshall Motor Bodies, Limited, Cambridge; T. R. MATTHEWS, personnel manager, George Kent, Limited, meter manufacturers and engineers, of Luton; T. MILNER, manager, rolling mill, Frederick Braby & Company, Limited, Glasgow; H. F. MORTON, chief works engineer, De Havilland Propellers, Limited, Bolton; J. W. R. NADEN, chief metallurgist, Chesterfield Tube Company, Limited; H. O. NORWOOD, workshops manager, Atomic Energy Research Establishment, Ministry of Supply, Harwell; C. A. PACKER, principal of the apprenticeship school of G. & J. Weir, Limited, engineers and founders of Glasgow.

A. J. PARSONS, experimental test and research engineer, Mawdsley's, Limited, dynamo and motor manufacturers, of Dursley; R. J. PEAKE, senior executive officer, Ministry of Materials; V. R. F. PEERS, designer, Simplex Electric Company, Limited, Birmingham; S. F. PERRY, manager of experimental department, Vickers-Armstrongs, Limited, Winchester; M. SAUNDERS, district operating superintendent, Rugby, Railway Executive; H. E. SHARP, chief technical engineer and head of research department, John I. Thornycroft & Company, Limited, Southampton; J. SKINNER, works and production director, Howard & Bullough, Limited, cotton machinery makers, of Accrington; G. SWAIN, works manager, James Neill & Company (Sheffield), Limited, steelmakers; S. B. TAYLOR, manager, Government contracts, English Electric Company, Limited, Bradford; R. A. TWITCHIN, head of exports assistance department, National Union of Manufacturers.

B.E.M.

W. H. ADDIS, foreman, George Senior & Sons, Limited, forgers, etc., of Sheffield; T. H. BARROW, staff trainer and vacuum operator, Wm. Adams & Son, Limited, brassfounders, etc., of West Bromwich; W. G. BELCHAM, technician, grade III, Military Engineering Experimental Establishment, Ministry of Supply, Christchurch; C. E. CAIRNS, assistant foreman fitter, Harland & Wolff, Limited, Belfast; J. GIRVAN, assistant foreman, Singer Manufacturing Company, Limited, Clydebank; G. GODDING, switchgear fitter, General Electric Company, Limited; J. H. HARRALD, fitting shop foreman, Robert Boby, Limited, engineers, of Bury St. Edmunds.

G. P. HIBBS, leading patternmaker, British Thomson-Houston Company, Limited, Rugby; J. KENNEDY, supervising steel erector, Carter Horseley (Engineers),

(*Concluded at foot of Col.* 2)

Peat-burning Gas Turbine

The first peat-burning gas turbine in the world, now running at the Clydebank works of John Brown & Company, Limited, was visited recently by the Scottish Peat Committee under the chairmanship of Sir Edward Appleton, F.R.S.

The plant consists of the firm's 500 h.p. experimental gas turbine, which was first run on oil four years ago and is now equipped with a peat-burning air heater and peat-drying equipment. It was designed by Parsons and Marine Engine Turbine Research and Development Association but built entirely at Clydebank. Initially it was run on the open cycle for over 1,000 hours, but it was decided to convert the plant to a closed cycle, and it was first run on this system in December, 1949. Between then and last August 2,500 hours' running was carried out.

Speaking at a luncheon which followed the committee's inspection, Sir Edward Appleton recalled that the project was initiated when the Scottish Peat Committee was appointed in 1949 to advise on the development of Scottish peat deposits.

In gas turbine research, he continued, they had seen that day the first fruits of research into burning peat in the closed cycle turbine, and that John Brown & Company should have been able to achieve the results it had in so short a time was remarkable. Another type of peat-fired gas turbine, the open cycle turbine, was being developed by Ruston & Hornsby, Limited, Lincoln.

Anglo-Swedish Trade

Trade negotiations which have been proceeding in London between delegations representing the U.K. and Sweden have now been successfully concluded. The negotiations covered deliveries of iron ore and other commodities to the U.K. for the whole of 1952, and of coal, coke, steel, and other materials to Sweden for the same period.

Limited; J. LENNIE, stove and range metal fitter, Smith & Wellstood, Limited, Bonnybridge; W. MILLARD, foreman, Crane, Limited, Ipswich; J. MOORE, ratefixer, Morris Motors, Limited; G. NIMMO, foreman shipwright, Ayr Engineering & Constructional Company, Limited; T. O'HARA, mechanical maintenance foreman, British Tabulating Machine Company, Limited, Castlereagh; F. PEARCE, foreman electrician, Troughton & Young, Limited, electrical engineers, of London, S.W.1.

E. T. SMITH, foreman in charge, Margam Works reconstruction gang, Steel Company of Wales; W. SOUTER, foreman, Henry Wiggin & Company, Limited, nickel manufacturers, of Birmingham; J. TAIT, head foreman ironman, Middle Docks & Engineering Company, Limited, South Shields; G. W. THWAITES, foreman bricklayer, Dorman, Long & Company, Limited, Middlesbrough; E. C. TUNNICLIFFE, general foreman, Standard Telephones & Cables, Limited, Treforest; J. M. WALKER, brass finisher, Parkinson & Cowan (Gas Meters), Limited, Manchester; J. WILKES, foreman, Imperial Chemical Industries, Limited; W. WILKINSON, leading boilermaker, Daniel Adamson & Company, Limited, Dukinfield; T. J. DAVIES, line leader, salvage section, Hoover (Washing Machines), Limited; S. E. DENT, head roller, Consett Iron Company, Limited, Co. Durham; W. S. DICK, working caulker, Furness Shipbuilding Company, Limited, Bilingham; A. DUXBURY, shuttlemaker, Kirk & Company (Blackburn), Limited.

Basic-lined Water-cooled Cupola at Lynchburg Foundry*

By W. W. Levi

(Slightly Abridged)

The advent of the process for the production of grey cast iron with graphite in nodular or spheroidal form in the as-cast condition is one of the principal reasons for the installation of a basic cupola. Another important reason is the need for high-carbon iron used in the manufacture of Super deLavaud pipe. The high-carbon iron required can, of course, be obtained from acid cupolas by using mixtures containing relatively large percentages of pig-iron. However, sufficient quantities of pig-iron have not always been available, and this is particularly true in times of peak production. It has now been definitely established that iron admirably suited for spun pipe can be produced in the basic cupola with little or no pig-iron, and from 50 to 70 per cent. of steel scrap in the charge.

Shortly after the basic cupola was put into operation by Lynchburg Foundry it became evident that the iron produced could well be used as a substitute for purchased pig-iron in the acid cupolas both at Radford and Lynchburg. The sulphur content is lower than that in most of the merchant iron received, and the carbon content is at a uniformly high level. The silicon content can be adjusted to almost any desired range, and results to date indicate that it can be controlled within reasonably narrow limits. For example, it was recently desired to produce a particular wagonload of pig-iron with approximately 1 per cent. silicon. While it was being made, ten samples for analysis were taken and results showed a minimum of 0.95 per cent. silicon, and a maximum of 1.16 per cent. silicon, with an average for all ten samples of 1.09 per cent. silicon.

Requirements of Ductile Iron

Whilst many readers are familiar with the requirements of irons best suited to the production of ductile-iron castings, a brief summary will be given here to point out the necessity for using irons of low sulphur content. The process for the production of nodular-iron castings consists, briefly, of making an addition of a magnesium-bearing alloy to a high-quality molten cast iron, followed by inoculation with a powerful graphitizing agent, such as ordinary ferro-silicon. The magnesium addition in itself functions in three ways:—

(1) It reduces the sulphur content of the iron to a very low level; (2) It is responsible for the formation of spheroidal graphite in the as-cast state instead of flake graphite in grey iron castings, and (3) it is a powerful hardening agent.

For this discussion the interest is primarily in item (1), namely, the desulphurizing effect of the magnesium addition. Sufficient magnesium in the form of a suitable alloy must be added to reduce the sulphur content of the iron to about 0.005 to 0.02 per cent. Not until the sulphur has been reduced to this level does the excess magnesium present act to form spheroidal graphite. From what has just been said, it is obvious that the lower the sulphur content of the iron intended for ductile iron castings the better, principally because less of the expensive magnesium alloys will be required.

Earlier British Work

In the FOUNDRY TRADE JOURNAL for October 10, 1949, there appeared an article entitled " Some Modifications in Cupola Design " by E. S. Renshaw and S. J. Sargood of Ford Motor Company, Limited, Dagenham, England. Among other things, this article describes the construction of a basic-lined, water-cooled, production cupola and reports results of chemical analysis of the iron produced. Sulphur levels are unusually low and carbon levels somewhat higher than would be expected in ordinary practice. It should be pointed out here that an extremely high carbon was not desired in the castings for which the particular unit in question was melting iron. In February, 1950, the writer had the privilege of visiting some of the foundries in England and France with his colleague Mr. Max Kuniansky, and discussed the basic cupola and its possibilities at considerable length with Mr. Renshaw. Based on his knowledge of American cupola practice and fuels available in the United States, Mr. Renshaw felt confident that the Lynchburg Company should be able to obtain results at least equal to, and probably better than those attained abroad. With this encouragement, the management decided to install a basic-lined, water-cooled cupola at the Radford plant.

Based on information available at the time, it was evident that the amount of silicon lost during melting in basic cupolas would be relatively high. (In acid practice a silicon loss of 10 per cent. of the silicon in the charge is normal.) Losses up to 20 per cent. were reported as more or less " normal " in the basic cupola, and Mr. Tom Curry, another member of the staff, reported that in some of the well-run basic cupolas which he saw in operation in England in the summer of 1950, the silicon loss was calculated to be 0.50 per cent. regardless of the silicon content of the ingoing charge. This, of course, represents a rather high loss, particularly if

* Article appearing in *The Iron Worker*, the house organ of the Lynchburg Foundry Company, Virginia, U.S.A.

Basic-lined Water-cooled Cupola

the ingoing silicon content is in the neighbourhood of 1.5 per cent. or less.

Hot Blast

Research has pointed out that increasing cupola air-blast temperature reduces silicon losses during melting in normal practice, and it was felt that these findings would hold true to some extent, at least, in basic practice. In view of the fact that silicon is an expensive commodity, a cupola air-blast heater was installed in conjunction with the new cupola.

The hot-blast heat-exchanger is known as a "Todd-Thermo Air Heater" and was purchased from Todd Shipyards Corporation, Combustion Equipment Division in New York. It is oil-fired and has a capacity of 13,000 cub. ft. of air per min. which can be heated to a maximum temperature of 1,000 deg. F. (535 deg. C.) through a heating surface of approximately 4,100 sq. ft. The heat exchanger is approximately 13 ft. long, 10 ft. wide and 19 ft. high. The blast temperature is held within very narrow limits by means of automatic control equipment of the modulating type. This results in much closer control than generally can be obtained with the "on-and-off" type control. Only one burner is required, and oil atomisers of different sizes are used in the burner to take care of the various load requirements imposed on the heater. So far, the air demand has been between 450 and 600 lb. per min. (approximately 5,800 to 7,800 cub. ft. per min.) with temperatures ranging from 500 to 900 deg. F. (260 to 480 deg. C.). It has been necessary to use only one size of atomiser in the burner to take care of the range of requirements just mentioned.

In order to avoid damage to the heater, the cupola air-blast is brought up to operating temperature at a maximum rate of 20 deg. F. per min. This rate is controlled manually until the air-blast is within 50 deg. F. of operating temperature, and then the control is turned over to the automatic equipment. After the heater has been in operation for a period of an hour or more and it is desired to change the blast temperature, it can be done by simply re-setting the automatic controls, provided the change does not exceed 100 deg. F.

During the "warm-up" period, air going through the heat-exchanger is by-passed to the atmosphere. As soon as it has reached the desired operating temperature it is turned into the cupola and melting starts, thus providing hot air at a predetermined temperature from the very beginning of the heat.

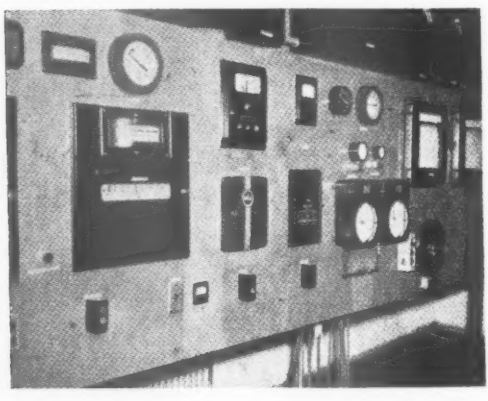


FIG. 1.—*General View of Instrument Panel Board in the Control Room. These Instruments are used in connection with the Cupola Air-blast Heater.*

Safety Devices

In connection with the heater there are a number of built-in safety devices designed to protect both the heater and the cupola. For example, if the water pressure in the cooling tubes inside the cupola (to be described later) falls below a certain minimum, the cupola blower is automatically shut off, and when the blower stops, or the air flow falls below a certain level, the burner in the combustion chamber goes out. If the burner flame goes out, the oil flow to the burner stops for a length of time sufficient to purge the combustion chamber of any explosive air/oil mixture, and if the combustion-air blower fails, the flow of oil to the burner is cut off.

In case of failure of any of the thermocouples in the system, there is a signal light to indicate that this condition exists. There is a full-time operator in charge and it is his duty to make routine visual inspection of all control instruments to see that the desired conditions are maintained at all times. A recording-control instrument makes a continuous record of the cupola air-blast temperature.

When using about 550 lb. of air per min. heated to a temperature of 850 deg. F., the rate of consumption of No. 2 fuel oil is approximately 60 gall. per hour. At the time of writing, the heater has been at operating temperature for more than 800 hrs., and inspection indicates a very satisfactory condition inside both the heat-exchanger and the combustion chamber.

The basic cupola was designed by the Lynchburg Foundry Company after consultation with Renshaw, Vennerholm, Payne, Bamford, H. K. McGavock, the chief design engineer, and the metallurgical staff of the Lynchburg Company. It is not a made-over or re-vamped cupola, but one which is brand new, standing in the place of one of the four cupolas which have been furnishing iron to the Radford plant for many years.

First Lynchburg Design

The cupola shell has an internal diameter of 96 in. from the mandrel plate up to, and including, the charge-door opening, while the upper portion of the stack is 72 in. int. dia. In the original design the water-cooled melting-zone section was formed by 60 extra-heavy 2½-in. hot-rolled seamless steel tubes. They were arranged in the form of a truncated cone having a vertical height of about 7 ft. 4 in. The diameter at the bottom was 5 ft. 6 in., and the diameter at the top 7 ft. 5 in. The small

diameter was located just above the tuyere openings, the purpose of this design being to provide an over-hang and thus prevent molten slag and iron from entering the tuyeres during their descent from the melting zone to the cupola well. The well of the cupola is lined with hard-burned magnesite brick, and one course of magnesite brick 4½ in. thick was laid over the conical surface formed by the cooling tubes. It is now felt that the original design had some shortcomings but in spite of this, much was learned from it concerning the operation of the water-cooled, basic-lined cupola.

Tap-hole Construction

The cupola is of the front-slagging type and one of the first problems was to find suitable refractories for the tap-hole construction, as well as for the trough and slag dam. With the highly-basic slag formed and high temperature encountered (upwards of 1,600 deg. C. at times) attack on the brickwork was extremely severe. For the tap-hole, the first trials were with various sizes and shapes of water-coolers, but these were abandoned after a few heats because it was felt that they were unsafe. There was then tried a long list of different kinds of basic brick, including stabilised dolomite brick, and a number of types of basic-ramming refractories. None of these materials proved satisfactory under these particular operating conditions.

The best tap-hole construction so far found is a combination of carbon bricks and hard-burned magnesite bricks. The carbon bricks are used to form the top of the tap-hole where they come in contact with slag only. Under these conditions it appears they will last for long periods of time provided that no free oxygen contacts them while they are at elevated temperatures. The bricks forming the sides and bottom of the tap-hole should be of hard-burned magnesite with the lowest ferric-oxide content possible. Tap-holes built as thus described have been in continuous service in heats lasting from 24 to 30 hr., and the carbon bricks show remarkable resistance to slag attack as indicated by inspection at the end of the heats. The same grade of magnesite bricks as used to form the sides of the tap-hole has been found satisfactory for lining the cupola trough from the tap-hole out to, and including, the slag dam.

Modified Design

After a number of heats, it became evident that it was necessary to operate the cupola relatively slowly in order to produce the low-sulphur, high-carbon irons desired. Under these conditions some excellent results were obtained but production rates were unsatisfactory. Therefore, the original cupola design was re-examined and it was reasoned that the cone-shaped, water-cooled melting zone previously described was undesirable. It was decided to rearrange the cooling tubes so that they are now parallel with the cupola shell. At the same time, 12 water-cooled copper tuyeres projecting in beyond the surface of the cupola lining were installed. A feature of these tuyeres is that the distance they project can be adjusted over a 5-in. range. Thus, the circle bounded by them can be as small as 62 in. or as large as 72 in. dia. At present, they form a 66-in. circle.

After making the design changes mentioned above, the cupola was put back into service on June 29, 1951. Since that date, the charges used have contained from 50 to 70 per cent. of steel scrap. The actual make-up of three cupola mixtures using 50 per cent., 60 per cent. and 70 per cent. of steel respectively, the flux charge used (same for all three mixtures), and a brief summary of results obtained are given in the Table I.

TABLE I.—*Cupola Charge Mixtures.*

Materials.	50 per cent. steel, (9.7.51).	60 per cent. steel, (19.7.51).	70 per cent. steel, (31.7.51).
Steel scrap	1,000 lb.	1,200 lb.	1,400 lb.
Malleable pig	400 lb.	None	None
Cast scrap	525 lb.	700 lb.	500 lb.
Silvery (15 per cent. Si) pig	75 lb.	None	None
Silvery (9.8 per cent. Si) pig	None	100 lb.	100 lb.
Briquettes (2 lb. Si)	1	4	1
Calculated in the charge, per cent.			
Total carbon	1.85	1.48	1.17
Silicon	1.61	1.61	1.20
Manganese	0.51	0.51	0.49
Sulphur	0.054	0.058	0.050
Phosphorus	0.26	0.27	0.20
At cupola spout, average per cent.			
Total carbon	4.21	4.12	3.96
Silicon	1.42	1.51	1.09
Manganese	0.55	0.51	0.52
Sulphur	0.018	0.024	0.014
Phosphorus	0.24	0.25	0.24
Silicon melting loss, per cent.	11.8	6.2	9.2
Carbon pick-up, per cent.	2.36	2.64	2.79
Cupola blast temperature	850 deg. F.	850 deg. F.	850 deg. F.

Flux Charge—All Mixtures.

Dolomitic stone	100 lb.
Carbide	50 lb.
Spar	20 lb.
Fused soda ash	4 lb.

Control Procedure

In connection with all of the iron melted in the basic cupola, determinations for silicon, sulphur, and total carbon in the iron are made every 30 min., and temperature of the iron at the cupola spout is read periodically. The iron oxide (FeO) content of the slag is determined every 30 min. and the lime, silica, magnesia, and alumina are determined every 2 hrs. Results obtained during five consecutive hours of operation when melting 70 per cent. steel in the charge are typical of all heats and are given in Table II.

It may be of interest to note that metal produced was poured into a pig-casting machine and despatched to the Lynchburg plant for use as a special-purpose pig-iron.

Slags having chemical compositions falling within the ranges of those shown in connection with the cupola heat described above are considered very strongly basic in comparison with ordinary so-called "acid" cupola slag. A number of slag samples from the "acid" cupolas at the Radford plant have been analysed and results obtained are tabulated along with results of analysis of slags from the "basic" cupola in Table III.

Basic-lined Water-cooled Cupola

It appears that practically all of the sulphur in molten cast iron is present in the form of iron sulphide (FeS) and that to obtain the high order of sulphur reduction achieved in the basic cupola, the slag must contain a relatively high percentage of lime (CaO). At high temperatures, and in the presence of carbon or coke in the cupola, the lime in the slag reacts with the iron sulphide forming " pure " iron (" pure " in this case means no longer combined with sulphur), calcium sulphide, and carbon monoxide. Thus:—

(1) $FeS + CaO + C = Fe + CaS + CO$.

The calcium sulphide (CaS) formed is absorbed in the slag and is removed from the cupola just about as fast as it is produced. For the reaction shown in equation (1) to proceed favourably, it is of utmost importance that the iron oxide (FeO) content of the slag be held at as low a level as is possible. Otherwise, some of the calcium sulphide formed in equation (1) will react with the iron oxide (FeO) to form a complex compound of calcium and iron oxides (CaO-FeO) and iron sulphide (FeS) in accordance with the following equation:

(2) $CaS + 2FeO = CaO.FeO + FeS$.

In other words, equation (2) shows that the desulphurizing power of the slag is reduced as its iron-oxide content increases, because some of the lime in the slag is consumed and consequently is not available to react with iron sulphide in accordance with the first equation. Basic refractories cost about five times as much as acid refractories and, from this, it is obvious that every effort must be made to conserve them and hence the elaborate cooling arrangements.

Temperatures

Experience to date, indicates that high melting temperatures are essential to the successful operation of the basic cupola if one is to produce irons with low-sulphur and high-carbon contents from charges containing upwards of 50 per cent. of steel scrap. High melting temperatures are generally accompanied by good slag fluidity and this, in turn, results in good sulphur removal. Good slag fluidity resulting from high melting temperature has an added advantage in that this condition reduces the amount of fluorspar required in the flux charge. The attack by fluorspar on the refractories now in use is extremely severe and, consequently, the smaller the quantity used the better, all other things being equal. All good practices normally followed in connection with the operation of acid cupolas must be adhered to when operating a basic cupola, and careful supervision is required at all times. The iron yard must be kept in first-class order from the standpoint of housekeeping, and only scrap and iron reasonably free of adhering sand should be charged. In wet weather, there is danger of charging large quantities of sand into the cupola in the form of mud upon the metal. This can seriously effect slag composition and result in undesirable changes in composition of the iron.

TABLE II.—*Typical Results Obtained.*

	Iron.			Metal Temp., deg. C.	Cupola slag.				
	Per cent. T.C.	Per cent. Si.	Per cent. S.		Per cent. FeO.	Per cent. CaO.	Per cent. SiO_2.	Per cent. MgO.	Per cent. Al_2O_3.
	3.98	1.12	0.013	—	0.70	52.68	29.52	8.92	4.30
	4.01	0.95	0.010	—	0.80				
	3.92	1.12	0.015	1,600	0.70				
	3.97	1.13	0.012	—	0.76				
	4.05	1.06	0.014	1,630	0.76	54.68	26.88	7.40	4.46
	3.94	1.05	0.010	—	0.78				
	3.82	1.12	0.012	1,600	0.67				
	3.94	1.03	0.016	1,590	0.74				
	3.94	1.14	0.018	—	0.74	56.24	26.60	6.80	4.76
	4.02	1.16	0.015	—	0.80				
Average ..	3.96	1.09	0.014	1,605	0.75	54.53	27.67	7.71	4.51

TABLE III.—*Typical Cupola Slag Compositions.*

	Composition, per cent.	
	" Acid."	" Basic."
CaO	19 to 22	50 to 56
MgO	10 to 13	7 to 11
SiO_2	46 to 51	27 to 32
Al_2O_3	10 to 12	4 to 8
FeO	0.5 to 3	0.40 to 0.88

At the present time, the new cupola is being operated for twenty-four hours per day on alternate days, and at the time of writing has produced nearly 7,000 tons of iron for deLavaud pipe, and approximately 2,000 tons of pig-iron. As more experience is gained, and perhaps through the development and application of better refractories, it is hoped that it can be operated continuously for at least 120 hours.

STEWARTS AND LLOYDS, LIMITED, announced a Christmas box worth thousands of pounds, for their retired employees. Pensions paid to more than 800 of their former workers in Scotland are to be raised by at least half immediately. Chairman of the company, Mr. A. G. Stewart, told the good news to 400 pensioners at a Christmas treat in Airdrie Town Hall at the year's end. He said: " The increase goes only to men who were paid by the hour." The firm had a record output during the past year.

PRODUCTION of crude oil and natural gasoline for 1951 is provisionally estimated by the Petroleum Information Bureau at the world-record level of 600,000,000 metric tons, 10 per cent. more than last year's record output of 543,000,000 metric tons. The United States again provided over half the total output. The largest Commonwealth producer was Canada, which together with British Borneo produced over 11,000,000 metric tons. Persia does not appear on this year's list of major producers.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

BIRKENHEAD, January 23—Iron, steel, iron castings, zinc boiler plates, nails, rivets, etc., for the Town Council. The General Manager, Birkenhead Corporation, Ferries, Woodside Ferry, Birkenhead.

BOOTLE, January 19—Cast-iron manhole covers and gully grates, etc., for the Borough Council. The Borough Surveyor, Town Hall, Bootle.

GILLINGHAM, February 5—Cast-iron manhole covers, road gully gratings, frames, road traffic signs, etc., for the Borough Council. The Borough Engineer and Surveyor, Municipal Buildings, Gillingham.

HUNTINGDON, January 31—Road traffic signs, etc., for the Hunts County Council. Mr. T. H. Longstaff, county surveyor, Walden House, Huntingdon.

LONDON, E., January 23—Sewer ironwork, for the Hackney Borough Council. The Borough Engineer and Surveyor, Town Hall, Hackney, London, E.8. (Deposit, £1 1s.)

NORTH RIDING, January 21—Cast-iron manhole covers, kerb outlets, gullies and grates, for the County Council. The County Surveyor, County Hall, Northallerton.

NORTHWOOD, February 9—Castings, for the Urban District Council. The Engineer and Surveyor, Council Offices, Northwood.

PRESTWICH, February 2—Cast-iron manhole covers, for the Borough Council. The Borough Engineer, Town Hall, Prestwich.

SCUNTHORPE, February 2—Castings, for the Borough Council. The Borough Engineer and Surveyor, Comforts Avenue, Scunthorpe.

STEVENAGE, January 31—Cast-iron manhole covers and frames, for the Urban District Council. Mr. J. D. Marshall, Council Offices, Stevenage.

TRURO, January 28—Cast-iron gully gratings, frames, weirs, traffic signs, stone crusher jaws, drill steel, road studs, etc., for the Cornwall County Council. The County Surveyor, County Hall, Truro.

BRISTOL, January 15—Supply and installation of road traffic control light signals, for the City Council. Mr. J. B. Bennett, Arno's Court, 470, Bath Road, Bristol, 4.

CEIRIOG, January 14—Supply and laying of approx. 1,500 yds. of 3 in. and 4 in. dia. cast-iron pipes, etc., for the Rural District Council. Mr. R. W. Aubrey, surveyor, Council Offices, Chirk, nr. Wrexham. (Deposit, £3 3s.)

ECCLES, January 19—Provision and fixing of a 30-ton weighbridge, for the Town Council. The Borough Engineer and Surveyor, Town Hall, Eccles.

ESHER, January 21—One road weighbridge, for the Urban District Council. The Engineer and Surveyor, Council Offices, Esher. (Deposit, £1 1s.)

INDIA, January 19—11 kv. switches, for the Government of Travancore-Cochin. Room 1086 (CRE (IB) 78221/51).

INDIA, January 23—Ironclad service cut-outs, for the Government of Travancore-Cochin. Room 1086 (CRE (IB) 78222/51).

INDIA, February 2—Meters and measuring instruments, for the Government of Travancore-Cochin. Room 1084 (CRE (IB) 78223/51).

National Training Scheme

The West Midland Foundry Advisory Committee, of which Mr. R. Forbes Baird is honorary secretary, has had a sub-committee at work for several months on a proposed national foundry apprenticeship training scheme. The sub-committee has completed a programme, "Recommendations to Employers Covering Training in Moulding and Coremaking," and at a meeting of the Committee on January 3, its recommendations were approved and it was agreed that a copy should be sent to each of the affiliated associations (which include, *inter alia*, the Light Metal Founders' Association, the Engineering and Allied Employers' Association, the Institute of British Foundrymen, the Midland Ironfounders' Association and the National Association of Malleable Ironfounders) for their comments, and to ask the Council of Ironfoundry Associations to sponsor the adoption of the scheme at its March meeting.

Notes from the Branches

Scottish Branch, N.E. Section

The fourth meeting of the North Eastern section of the Scottish branch of the Institute of British Foundrymen this session was held at the Imperial Hotel, Arbroath, on December 19. Provost Webster opened the proceedings by presenting his presidential address. This took the form of a survey of the developments in foundry practice and conditions since the beginning of the century. The Provost concluded by saying that the future of the Institute depended on the members who attended the meetings, and he urged them to contribute to the section's activities by writing papers or by taking an active part in the discussions. The address was followed by a Paper presented by Mr. H. J. M. Conacher and Mr. R. Leeks, entitled "Production of Castings for a Small Diesel Engine." The Paper was well illustrated with slides and an interesting discussion followed. It is hoped shortly to print it in the JOURNAL.

West Riding of Yorkshire

The annual social evening of the West Riding of Yorkshire branch of the Institute of British Foundrymen was held at the Alexandra Hall, Halifax. It took the form of a supper-dance. The function was presided over by Mr. R. L. Simpson and the principal guests were Mr. Colin Gresty, the president of the Institute, who was accompanied by Mrs. Gresty, and Mr. T. Makemson, M.B.E.

Iron-ore Imports

Imports of iron ore in November and the first 11 months of the year, with comparative figures for 1950, are shown below. There were no imports of manganiferous ore during the first 11 months of this year. In the first 11 months of 1950, 10,876 tons of manganiferous ore were imported, against 7,006 tons in the corresponding period of 1949.

Country of origin.	Month ended November 30.		Eleven months ended November 30.	
	1950.	1951.	1950.	1951.
	Tons.	Tons.	Tons.	Tons.
Sierra Leone	65,870	70,295	685,781	562,174
Canada	39,030	94,840	100,628	624,192
Other Commonwealth countries and the Irish Republic ..	2,440	11,972	25,930	49,388
Sweden	269,669	342,564	3,153,674	3,195,592
Netherlands	4,922	2,174	40,531	42,587
France	32,831	33,268	349,395	329,703
Spain	41,926	50,935	693,462	729,356
Algeria	91,960	107,227	1,364,088	1,310,149
Tunis	21,550	32,720	439,264	454,478
Spanish ports in North Africa	25,550	19,830	416,969	304,831
Morocco	11,830	33,355	274,650	264,602
Other foreign countries	16,610	28,857	229,641	196,201
TOTAL	624,188	828,037	7,774,022	8,063,313

THE PRICE of hard coke was increased on December 31 by 8s. 8d. per ton, ex works, plus charge increases ranging from 1s. 1d. to 3s. 4d. per ton. On Monday (January 7) gas coke prices were increased by amounts varying from 6s. 8d. to 10s. per ton, according to area.

NEGOTIATIONS for raising additional finance were in progress with Mr. A. P. Good, chairman of Associated British Engineering, Limited, Loughborough, it was stated at a meeting of Specialloid, Limited, piston manufacturers, etc., of London, N.12, on December 31. A new board of directors was elected at the meeting.

Pig-iron and Steel Production

Statistical Summary of October Returns

The following particulars of pig-iron and steel produced in Great Britain have been extracted from the Statistical Bulletin for November, issued by the British Iron and Steel Federation. Table I summarizes activities during the previous six months; Table II gives the production of steel ingots and castings in October, Table III gives deliveries of finished steel, and Table IV the production of pig-iron and ferro-alloys in October. (References applicable are given at the foot of column 2.)

TABLE I.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported iron ore consumed.	Coke receipts at blast furnaces.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Imports.[2]	Output of ingots and castings.	Deliveries of finished steel.	Stocks.[3]
1949	258	169	199	183	188	17	299	233	1,071
1950	249	174	197	185	197	9	313	239	997
1951—May[1]	287	159	204	182	180	7	305	242	762
June	315	159	204	183	182	7	308	262	737
July	299	162	202	182	153	9	256	226	706
August[1]	280	176	203	181	147	8	266	190	713
September ..	303	184	207	190	175	10	303	253	659
October[1]	278	180	210	190	174	11	301	242	595

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in October*, 1951. (*Thousands of Tons.*)

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex ..	—	3.1	11.0(basic)	1.4	0.2	15.0	0.7	15.7
Lancs. (excl. N.W. Coast), Denbigh, Flints., and Cheshire	1.4	19.0	—	1.8	0.5	21.6	1.1	22.7
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	27.8	—	—	0.1	27.8	0.1	27.9
North-East Coast	1.8	56.9	—	1.2	0.5	58.5	1.9	60.4
Scotland	4.2	34.8	—	1.5	0.8	39.3	2.0	41.3
Staffs., Shrops., Worcs. and Warwick	—	14.8	—	0.9	0.8	14.9	1.6	16.5
South Wales and Monmouthshire	8.1	50.9	5.7(basic)	1.0	0.1	65.3	0.5	65.8
Sheffield (incl. small quantity in Manchester) ..	8.7	24.4	—	8.8	0.6	40.3	2.2	42.5
North-West Coast	0.7	1.1	5.5 (acid)	0.4	0.1	7.6	0.2	7.8
Total	24.9	232.8	22.2	17.0	3.7	290.3	10.3	300.6[1]
September, 1951	25.1	234.8	22.5	16.9	3.6	292.9	10.0	302.9
October, 1950	25.9	260.5	22.2	15.6	3.5	318.6	9.1	327.7

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1949.	1950.	1950 Oct.	1951. Sept.	1951. Oct.[1]
Non-alloy steel:					
Ingots, blooms, billets and slabs[4]	4.5	3.6	4.0	4.6	3.7
Heavy rails, sleepers, etc.	9.8	11.3	11.3	10.6	9.6
Plates ¼ in. thick and over ..	39.2	40.0	41.3	42.9	43.4
Other heavy prod.	37.5	40.2	41.3	41.0	38.5
Light-rolled prod.	46.4	47.6	52.6	49.1	46.6
Hot-rolled strip ..	17.1	19.4	22.1	21.6	19.3
Wire rods	15.4	16.3	17.8	16.6	16.2
Cold-rolled strip ..	4.9	5.5	5.9	6.8	6.4
Bright steel bars ..	5.6	6.2	7.1	6.7	6.1
Sheets, coated and uncoated ..	27.6	30.5	32.4	37.0	36.3
Tin, terne and blackplate ..	13.7	14.3	14.1	15.6	13.2
Tubes, pipes and fittings	18.5	20.0	21.4	23.3	22.7
Mild wire	12.0	12.6	13.9	12.3	12.3
Hard wire ..	3.2	3.5	4.0	3.5	3.6
Tyres, wheels and axles	4.1	3.5	3.0	4.5	4.2
Steel forgings (excl. drop forgings) ..	2.4	2.2	2.3	2.4	2.3
Steel castings ..	3.6	3.5	3.8	2.4	3.5
Total	265.5	280.2	298.3	300.9	287.9
Alloy steel	10.4	10.6	11.3	12.6	12.3
Total deliveries from U.K. prod.[5] ..	275.9	290.8	309.6	313.5	300.2
Add imported finished steel	9.5	3.8	2.3	7.3	5.6
	285.4	294.6	311.9	320.8	305.8
Deduct intra-industry conversion[6] ..	52.8	55.6	60.8	67.8	64.3
Total net deliveries ..	232.6	239.0	251.1	253.0	241.5

TABLE IV.—*Weekly Average Production of Pig-iron and Ferro-alloys during October*, 1951 (*Thousands of Tons*).

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	24	—	17.9	23.5	1.1	—	42.5
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	6	—	7.6	—	—	0.7	8.3
Yorkshire (incl. Sheffield, excl. N.E. Coast) ..							
Lincolnshire ..	13	—	24.2	—	—	—	24.2
North-East Coast	24	6.4	39.5	0.2	—	1.3	47.4
Scotland	9	0.7	12.7	2.9	—	—	16.3
Staffs., Shrops., Worcs. and Warwick ..	8	—	8.1	1.5	—	—	9.6
South Wales and Monmouthshire	8	3.1	21.3	—	—	—	24.4
North-West Coast	8	15.8	—	0.1	—	1.1	17.0
Total ..	100	26.0	131.3	28.2	1.1	3.1	189.7[7]
September, 1951..	102	27.2	129.7	27.9	1.6	3.1	189.5
October, 1950 ..	101	30.7	130.8	28.6	1.0	2.8	193.9

[1] Five weeks, all tables.

[2] Weekly average of calendar month.

[3] Stocks at the end of the years and months shown.

[4] Other than for conversion into any form of finished steel listed above.

[5] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

[6] Material for conversion into other products also listed in this table

Obituary

The death of MR. WILLIAM ADOLF IRVIN, who was president of the United States Steel Corporation from 1932 to 1938, has been reported from New York. He was 78.

MR. JOHN WALLACE, who has died at the age of 72, was secretary of Barr, Thomson & Company, Limited, engineers, of Kilmarnock. He succeeded to the post in 1905.

For almost 30 years until his retirement in 1933 DR. HERBERT F. STOCKDALE, who died at the end of last year, was director of the Royal Technical College, Glasgow. He was 83.

MR. JAMES HAMILTON, formerly manager of the Dalmuir shipyard of Wm. Beardmore & Company, Limited, has died, aged 82, at Kilchattan Bay, where he had lived in retirement for many years.

The death has occurred in Calcutta of SIR CYRIL SANKEY FOX, former director of the Geological Survey of India, at the age of 65. A mining graduate of the University of Birmingham, he joined the Geological Survey of India in 1911 as assistant superintendent and was appointed superintendent in 1930, and director in 1939. He was knighted in 1943 for services rendered for the survey and retired in the following year. During 1942-44, Sir Cyril was chairman of the fuel research and heavy chemical committees of the Council of Scientific and Industrial Research in India. After his retirement he prospected for uranium in the Egyptian desert, using a helicopter.

A former director and chief electrical engineer of Metropolitan-Vickers Electrical Company, Limited, Manchester, MR. GUSTAF ADOLF JUHLIN, has died at the age of 71. Born and educated in Sweden, he joined Metropolitan-Vickers (then the British Westinghouse Electrical & Manufacturing Company) in 1915 and was appointed chief engineer of the plant department in 1917. He became chief electrical engineer of the company in 1941 and later joined the board. He retired in 1947. A member of the Institution of Electrical Engineers and chairman of the North-west centre of the Institution from 1923 to 1934, Mr. Juhlin won an international reputation as a designer of large electrical generators.

The death occurred on December 27 of Mr. FRANCIS WILLIAM DUGDALE, a prominent Wearside shipbuilder and managing director of S. P. Austin & Son, Limited, Sunderland, since 1929. After obtaining his B.Sc. at Durham University, he served his apprenticeship with S. P. Austin & Son and the North Eastern Marine Engineering Company (1938), Limited, Wallsend-on-Tyne, followed by a short period at sea. In 1918 he joined Dudgeon & Gray, Limited, consulting marine engineers, of London, and took charge of its Newcastle-upon-Tyne branch. He returned to S. P. Austin & Son in 1923, being appointed assistant to his father, Mr. W. H. Dugdale, who was then managing director. He succeeded to the post of managing director on his father's death in 1929. He was elected a vice-president of the Shipbuilding Employers' Federation in 1945 and president in 1948. For many years a member of the council and a vice-president of the North East Coast Institution of Engineers and Shipbuilders, he was elected an honorary member of the council in 1950. Twice chairman of the Wear Shipbuilders' Association, Mr. Dugdale was also a member of the Institution of Naval Architects, the Institute of Marine Engineers, the Lloyd's Register technical committee, and the board of the River Wear Commission. He was elected president of the Sunderland Chamber of Commerce in 1942.

Personal

MR. J. WIGGLESWORTH has been appointed head of the department of engineering and mining at Wakefield Technical College.

THE CHAIRMAN of the Dunlop Rubber Company, Limited, Birmingham, SIR CLIVE BAILLIEU, has left on a two months' business tour of South Africa.

MR. A. A. LOMBARD has been appointed chief designer of the aeronautical division of Rolls-Royce, Limited, and MR. A. A. RUBBRA, deputy chief engineer of the same division.

SIR PERCY H. MILLS, managing director of W. & T. Avery, Limited, Soho Foundry, Smethwick, has been elected vice-chairman of the Board in succession to the late Sir William H. Wiggin.

A gold wrist watch has been presented to MR. THOMAS J. REED, who retired recently from the post of chief cashier of the Consett Iron Company, Limited (Co. Durham), after 51 years' service with the company.

LIEUT.-COLONEL W. SETON ANDERSON, of the Railway Executive staff training school at Derby, has been appointed principal of the executive's staff training schools at Darlington in succession to MR. J. KIRKBY THOMAS, who has been appointed head of the railway school of transport, Derby.

AFTER 38 years as maintenance engineer with Newton Chambers & Company, Limited, engineers and ironfounders, of Thorncliffe, near Sheffield, MR. J. HINGLEY has retired. He received a wallet and notes from the company, presented by Mr. G. C. Ibbotson, a local director, and a gold watch from the men.

IN LAST WEEK'S ISSUE, it was stated incorrectly that Mr. W. T. Bell, managing director of Robey & Company, Limited, of Lincoln, had been appointed Sheriff of the city. Actually, it is Mr. E. F. Needham, of Robey & Company, who holds this office. Apologies are tendered to all who have been inconvenienced by this error.

KEITH BLACKMAN LIMITED of Mill Mead Road, Tottenham, London, N.17, announced that Mr. D. S. Woodley has been appointed to act as joint managing director with Mr. M. Burningham as from January 1. Consequent upon this new appointment, Mr. S. E. Nelson, B.A.Cantab., will succeed Mr. Woodley as chief engineer of the company.

MR. J. SIDNEY HAMPTON, a director since 1945, has now also been appointed general manager of Davy and United Roll Foundry, Limited, the Middlesbrough subsidiary of Davy and United Engineering Company, Limited. Mr. Hampton is, of course, widely-known throughout the steel and non-ferrous industries as an authority on roll manufacture.

MR. W. H. ATHERTON & Mrs. Atherton, of Derby, celebrated their golden wedding on January 8. Mr. Atherton is now 84 and his wife 77. A well-known engineer, Mr. Atherton has given many years' service as a director of Ley's Malleable Castings Company Limited, of Derby. In 1905 he joined the Ewart Chainbelt Company, a company associated with Ley's, became a director of the parent company in 1914, and of the Ewart Company in 1919. A few years later the holding company Ley's Foundries & Engineering Limited was formed and Mr. Atherton became a director. He eventually retired from active business before the last war but still served as a consultant until a few years ago.

News in Brief

HEMEL HEMPSTEAD ENGINEERING COMPANY, LIMITED, Cupids Green, Hemel Hempstead, Herts, will shortly extend their foundry.

FORTH & CLYDE & SUNNYSIDE IRON COMPANY, LIMITED, Falkirk, are to erect a new roof over one bay of their enamelling shop at a cost of £1,160.

THE 1,000TH EXCAVATOR manufactured in 1951 by Ruston-Bucyrus, Limited, Lincoln, was despatched from the company's works on December 21.

THE WEST RIDING OF YORKSHIRE branch of the Institute of British Foundrymen announce the closing date for S. W. Wise Competition is February 19, 1952.

A NEW FACTORY for the manufacture of electrical gear has been rented by Whipp & Bourne, Limited, Castleton, Rochdale (Lancs), on the Queenslie Industrial Estate, Glasgow.

TEXTILE MACHINERY MAKERS, LIMITED, Oldham, announce the appointment of two new directors to their Board:—Sir Cuthbert Barwick Clegg, J.P., and Mr. George Hardman.

ORDERS FOR TWO CARGO STEAMERS of 9,000 tons each have been placed with John Readhead & Sons, Limited, South Shields, bringing the number of vessels on order with the company to 20.

MR. TOM BROWN has been appointed joint managing director of Sheepbridge Engineering Limited, Chesterfield, with Mr. A. V. Nicolle. Mr. Brown was formerly deputy managing director.

THE BRITISH TRANSPORT COMMISSION has announced the establishment of a traffic costing service, staffed by officers of the Railway and Road Haulage Executives, with offices in London, Glasgow, and York.

JOSEPH SANKEY & SONS, LIMITED, pressers and stampers, etc., of Bilston, are planning to extend their Hadley Castle works by the erection of a new seven-bay building covering an area of 170,000 sq. ft.

EX-ALDERMAN GEORGE CLARK received a birthday message from the management and staff of the Bryan Donkin Company, Limited, on his 91st birthday. Mr. Clark is still a director of the firm, and was formerly chairman and managing director.

INTERNATIONAL COMBUSTION COMPANY, LIMITED, Derby, are to manufacture two 515,000-lb. high-pressure boilers, for the new power station, at Drakelow, near Burton-on-Trent. Aiton and Company, Limited, Stores Road, Derby, are to supply high-pressure steam and feed piping.

NEWMAN INDUSTRIES, LIMITED, announce the departure of their Chairman, Mr. A. J. Newman, on a 30,000 miles business tour, by air, commencing on January 6. Mr. Newman's last tour of North America in the early months of 1951 resulted in his bringing back orders to the value of approximately £1 million.

AFTER A LAPSE OF MANY YEARS, the associates' section of the Staffordshire Iron and Steel Institute was reformed last week. It will cater for the needs of the Institute's under-25 members. The first chairman of the new section is Mr. Keith Goodchild, a metallurgical student at the Wednesbury Technical College.

A NUMBER of long-service awards were made recently by Mr. Vincent Jobson, chairman and managing director of Qualcast Limited, Derby, five to employees with over 20 yrs' service, and also to other employees with 10 yrs' service. Over 700 attended the social and presentation which was held at the King's Hall, Derby.

THE CLAIM by about 400,000 women engineers for an increase of £1 a week has been referred to the Industrial Disputes Tribunal following the failure of direct negotiations between the Engineering and Allied Employers' National Federation and leaders of five unions concerned. The employers' offer of an increase of 10s. a week was rejected.

A DINNER PARTY was held recently at the Royal Victoria Hotel, Sheffield, to celebrate the coming of age of Welding Rods, Limited. Founded by Mr. Harry Bull, its present chairman, and Mr. J. H. Aitcheson, who were both present at the dinner, the company numbers among its former chairmen the late Mr. Harry Brearley, the inventor of stainless steel.

UNDER A TRADE AGREEMENT concluded in Berlin last month between the Czechoslovak and the East German Republic for the period 1952-1955, Czechoslovakia will supply coke, rolled material, motor tyres, machinery, and chemical raw materials in exchange for machine tools, machine-tool equipment, mining equipment, equipment for the metallurgical and chemical industries, and other products.

AT THE fifth annual works dinner of Follsain-Wycliffe Foundries, Limited, the managing director, Mr. H. A. Bonney, stated that the foundry output in 1951 was an all-time record (an increase of 18 per cent. on the 1950 figure) and congratulated all concerned on their splendid efforts. A further award was made for thirty-years' service in the employ of the company, bringing the total number of recipients up to 28.

ALSTON (CUMBERLAND) RURAL COUNCIL has approved conditions laid down by the county planning officer for the proposed development of fluorspar mines at Cash Well and Tyne Head. The conditions include a proviso that all spoil, where practicable, shall be disposed of in the workings and in the event of extraction taking place from old spoil dumps the dumps shall be finally left neatly shaped and in a tidy condition.

UNITED KINGDOM MANUFACTURERS of Diesel electric locomotives who wish to be represented in Australia should communicate with H. G. Thornthwaite & Company, 43, Margaret Street, Sydney, New South Wales, giving details of equipment, as this firm wishes to act as agents. The Board of Trade, Commercial Relations and Exports Department, Thames House North, Millbank, London, S.W.1 (reference, CRE(IB)73469/51), should be notified of any action taken.

PROF. A. J. MURPHY, president of the Institute of Metals, and Lieut.-Col. S. C. Guillan, secretary, led the party of members which visited the Aitchison laboratories of the metallurgy department of the University of Birmingham on January 3. The laboratories, which were named to commemorate Prof. Leslie Aitchison who did so much to establish them, are equipped with very modern apparatus for research, and the work done there is always in close liaison with the metallurgical industries of the Midlands.

THE SOUTH EAST LONDON TECHNICAL COLLEGE, Lewisham Way, S.E.4, is organizing a course of lectures on modern foundry technique. The course, which will deal chiefly with non-ferrous metals, is due to commence on Tuesday evening, January 15, 1952, at 7 p.m. and is expected to extend over a period of 9 to 10 weeks on successive Tuesdays. It is hoped that the bulk of the following subject matter will be covered:—Methods of casting, including sand casting; die-casting; chill casting; special casting processes; fuels and melting furnaces; metal treatment and heat-treatment; properties of castings and economics governing the selection of materials, processes, etc. The fee for the course is £1 15s. and immediate applications are invited either in writing (enclosing fee) or in person.

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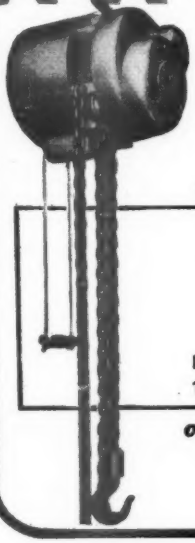

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Raw Material Markets

Iron and Steel

Increasing demands for castings were received throughout last year by the general engineering, speciality, and textile foundries, both on home account and for export, while additional business was also available to the jobbing and light foundries. And the New Year opened with every prospect of there being a prompt disposal of outputs for months ahead. Unfortunately, however, foundrymen are beset by many problems, and it is unlikely that they will be able to take advantage of the present heavy call for castings for a long time to come owing to their inability to obtain sufficient raw materials to enable them to carry out full production programmes. Shortages have caused many anxieties in recent months and have resulted in reduced outputs and, in some instances, short-time working. Most foundries are now dependent on day-to-day deliveries of pig-iron, scrap, and, in some cases, of coke.

As far as pig-iron supplies are concerned, the needs of the steelmakers daily become more insistent, reducing proportionately the quantities which can be sent to the foundries. Hopes are entertained that additional furnaces will be blown in to provide more iron for the foundries as well as satisfying the demands of the steelworks, but at present the situation is very tight. Pending developments foundries will continue to be harassed by their inability to obtain their pig-iron requirements. Higher prices of raw materials are envisaged on account of increased coal prices and additional railway charges, but it is the shortage of supplies that is causing most concern.

Stocks of scrap at the foundries are very low and parcels arising in both cast iron and steel go immediately into production. Little difficulty is experienced in obtaining supplies of ganister, limestone, and firebricks.

The re-rollers, who have plenty of orders on hand, are handicapped by scarcity of the small sizes of sections, bars, and strip, large quantities of which are required for priority work. They have little prospect of improving outputs on their present supply of semi-manufactured steel, and the outlook is obscure, with little hope of an early lessening of the difficulties which have affected them for some time. Only small quantities are forthcoming from home steelworks, and the recent reductions in imported material have removed any hopes which were entertained of early assistance from that source. The sheet re-rollers have heavy order-books, but are short of sheet bars to enable them to fulfil demands, and, with other re-rollers, are taking all the prime and defectives, crops, etc., which they can obtain.

Non-ferrous Metals

The outstanding feature in metals has been the sharp rise in the tin market following the news that the Reconstruction Finance Corporation Administrator, Mr. Symington, had resigned. The market interpreted this as meaning that a change of policy in the United States regarding tin was just round the corner, and there was buying of both cash and three months.

Last week closed with a backwardation of £9, whereas a week earlier the two position closed level, and in the interim a contango developed. The expectation that prompted this spurt of buying is, of course, that the United States will reappear as a buyer of tin on the world market, and in this event we shall probably see a higher price, possibly as much as £1,000, again.

But stocks in the U.K. have improved of late, and world production of the metal continues to outstrip consumption by a comfortable margin. True, America has allowed her reserves to decline, but they are still fairly ample, and certainly sufficient to exercise a depressing effect on prices were a general release made. That is what the producers of metals all over the world fear about stockpiling generally, and they have good grounds for apprehension, for it is impossible to forecast the trend of events over the next few years.

London Metal Exchange official tin quotations were as follow:

Cash—Thursday, £927 10s. to £928; Friday, £950 to £952 10s.; Monday, £952 10s. to £955; Tuesday, £942 10s. to £945; Wednesday, £952 10s. to £954.

Three Months—Thursday, £925 to £927 10s.; Friday, £942 10s. to £945; Monday, £947 10s. to £948; Tuesday, £940 to £942 10s.; Wednesday, £952 to £952 10s.

Although the International Materials Conference allocations of copper and zinc to the U.K. for the first quarter show some improvement on the last quarter of 1951, there is no indication that matters are any easier with the consumers. Scrap is very scarce and there are no grounds for believing that any improvement is likely in the foreseeable future. The new Order introduced before Christmas brought down the ceiling prices of copper and brass scrap to a lower level, but this was done mainly on account of the creation of an upper limit for secondary refined ingots and cathodes.

So far the improvement in the flow of scrap seems to be conspicuous by its absence and there is no news of any business in ingots or cathodes except on a toll basis. On the other hand, rumours persist that the Order is being contravened so far as scrap is concerned.

Zinc and Copper Restrictions Postponed

Manufacturers of goods in which the use of copper, zinc, and their alloys was banned by a Ministry of Supply Order in November—household appliances and electrical, gas, and builders' fittings were among the articles listed—are to have a further 20-day period in which to finish partly-made goods containing the metals.

The original Order (the Copper and Zinc Prohibited Uses (Ministry of Supply) (No. 2) Order, 1951, S.I. 1951, No. 1960) gave manufacturers until February 1, 1952, to use up stocks of fabricated or partly-processed zinc and copper. A new Order is to be made extending this period until February 20 and making amendments to the list of prohibited articles.

THE TREASURY announces that a new sterling payments agreement, valid for two years, which has been signed by representatives of the British and Spanish Governments who have been meeting in Madrid, will facilitate transfers in payment of goods and services between the Spanish monetary area and the United Kingdom and sterling area and certain other countries. It is hoped that the total volume of trade and payments between Spain and the sterling area in 1952 will exceed £40,000,000 in each direction.

FOUNDRYMEN in the Midlands area, have noted with interest the exchange of visits planned by the Chambers of Commerce of Birmingham and Lyons (France), by which it is suggested that each Chamber should nominate delegates to attend the engineering and hardware section of the British Industries Fair at Castle Bromwich, and the International Fair at Lyons. The proposal, which originated from Lyons, aims at fostering links between French and British industries and of facilitating the interchange of information of mutual advantage to both groups.